EDISON ELECTRIC INSTITUTE BULLETIN

NOVEMBER, 1941

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EDISON ELECTRIC INSTITUTE

THE ELECTRIC LIGHT AND POWER INDUSTRY

Current Statistical Data Covering 100 Per Cent of Industry

August, 1941

SOURCE AND DISPOSAL OF ENERGY—MONTH OF AUGUST

	1941	1940	%
GENERATION* (Net)			
By Fuel Burning Plants	10,610,211,000	8,475,640,000	+25.2
By Water Power Plants	3,929,636,000	3,968,158,000	− 1.0
Total Generation	**14,539,847,000**	**12,443,798,000**	**+16.8**
Add—Net Imports Over International Boundaries	63,905,000	79,677,000	−19.8
Less—Company Use	226,356,000	128,389,000	+76.3
Less—Energy Used by Producer	258,777,000	470,705,000	−45.0
Net Energy for Distribution	**14,118,619,000**	**11,924,381,000**	**+18.4**
Losses and Unaccounted for	2,037,461,000	1,819,400,000	+12.0
Sales to Ultimate Customers	**12,081,158,000**	**10,104,981,000**	**+19.6**

CLASSIFICATION OF SALES

NUMBER OF CUSTOMERS—As of August 31st			
Residential or Domestic	25,582,828	24,555,173	+ 4.2
Rural (Distinct Rural Rates)	967,292	672,929	.....
Commercial or Industrial:			
Small Light and Power	4,285,648	4,239,021	+ 0.9
Large Light and Power	173,437	180,563	
Other Customers	115,982	110,545	
Total Ultimate Customers	**31,125,187**	**29,758,231**	**+ 4.6**
KILOWATTHOUR SALES—During Month of August			
Residential or Domestic	1,969,498,000	1,827,998,000	+ 7.7
Rural (Distinct Rural Rates)	329,429,000	288,030,000	+14.4
Commercial or Industrial:			
Small Light and Power	2,131,426,000	1,915,360,000	+11.3
Large Light and Power	6,724,427,000	5,191,335,000	+29.5
Street and Highway Lighting	154,246,000	148,938,000	+ 3.6
Other Public Authorities	258,843,000	224,062,000	+15.5
Railways and Railroads:			
Street and Interurban Railways	300,348,000	299,146,000	+ 0.4
Electrified Steam Railroads	173,147,000	152,318,000	+13.7
Interdepartmental	39,794,000	57,794,000	−31.1
Total to Ultimate Customers	**12,081,158,000**	**10,104,981,000**	**+19.6**
Revenue from Ultimate Customers	**$223,560,900**	**$201,993,100**	**+10.7**

RESIDENTIAL OR DOMESTIC SERVICE (Revised Series)

AVERAGE CUSTOMER DATA—For the 12 Months Ended August 31st			
Kilowatthours per Customer	974	934	+ 4.3
Average Annual Bill	$36.72	$36.33	+ 1.1
Revenue per Kilowatthour	3.77¢	3.89¢	− 3.1

* By Courtesy of the Federal Power Commission.

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EDISON ELECTRIC INSTITUTE BULLETIN

Volume 9 NOVEMBER, 1941 No. 11

Conservation of Materials for Defense Wiring

Great Savings Possible Through Use of Modern Wiring Systems

By H. R. Stevenson and O. K. Coleman

Members EEI Wiring Sales Committee

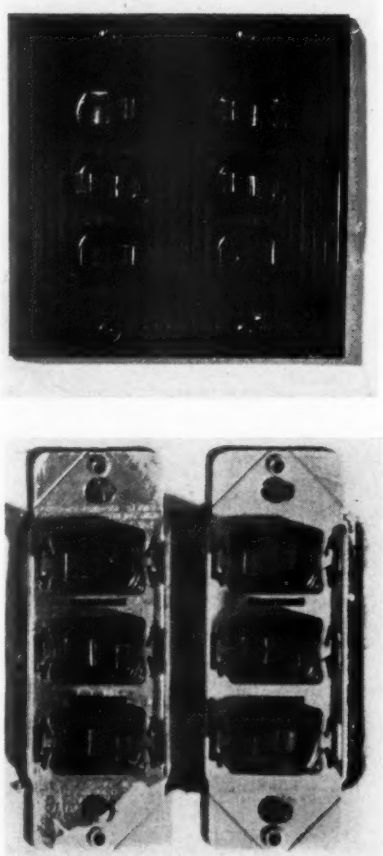
COPPER, and particularly insulated wire is becoming increasingly difficult to procure. It is altogether possible that some needed building will be seriously retarded because of the inability to secure the necessary wiring material.

Steel also is feeling the pinch of defense necessities, and it goes without saying that the steel requirements for the wiring of buildings should be held to the minimum of necessity. Steel in wiring systems is used only as a protective covering for insulated wires or other current carrying parts, and many thousand pounds of it are being used daily in wiring systems that not only could well do without it, but that would in many cases be improved by its omission.

Under present conditions wiring methods for all types of construction, excepting concrete, masonry and steel fireproof building, could and should, without loss of safety features, limit the use of steel to a very small percentage of that now being employed. Also if necessary methods could be developed within a short time and at little expense for the wiring of masonry buildings without the use of steel.

A large volume of the wiring work being done in this country is that done in residential occupancies and small commercial buildings, and it is this type of construction that will first feel, in fact is already feeling the scarcity of wiring materials. Materials will be allotted by the priorities system to the necessary industrial and other defense projects, but such residential and commercial that has to be done, must try to salvage sufficient wiring material from what is left.

For these reasons, if such residential and commercial building is to be continued at all, it is necessary, and at once, to begin to conserve on wiring materials. Also of even greater importance in the conservation of material, due to the greater volume involved, will be the application of the material saving methods to defense construction. Much of the defense construction will be of types that can use the same kind of wiring as residences and small commercial buildings, such as barracks, temporary houses and even emergency factory buildings.



Using non-metallic sheathed covered neutral cable this 4 in. square box easily accommodates four three-way switches, and two single pole switches.

As before mentioned steel for such buildings can be held to a very small minimum. There is no need for either conduit or steel tubing in the conventional residence or similar frame constructed buildings and its use now would be gross waste. For the outlets in walls and ceilings, porcelain or plastic boxes may be used in lieu of steel. They are available and there is no scarcity of porcelain at the present time. It is also possible that porcelain or plastic enclosures might be developed for switches and fuses that are now enclosed in steel; for instance at least one meter company is now offering a meter completely enclosed in porcelain and glass.

The average home of today requires 825 lineal feet of wire and this will serve 50 outlets in the house, including facilities for an electric range and water heater.

Using the present generally accepted method of wiring which is most economical of materials and which is approved by present codes, this amount of wire represents the use of 27 pounds of copper and 28 pounds of rubber insulation. In itself this is not a large amount of either of the scarce items, but if it is multiplied by the 900 homes being build monthly in one comparatively small defense area, it becomes important—24,000 pounds of copper and 25,000 pounds of

rubber. Extend this to the nation and the quantities become of sufficient volume to warrant careful study and consideration.

From this it is apparent that any small saving in either item becomes in total a saving worthwhile. In order to assure practical, safe and adequate wiring of those buildings required, and practically, therefore, the building of them, steps should be taken to consider means whereby every ounce of such materials can be conserved and devoted most advantageously to defense efforts.

The Covered Neutral Wiring System

For a number of years the Light and Power and some other groups in the electrical industry have worked for approval of wiring methods which will save copper, rubber, steel and other materials. One such method recommended for the wiring of frame buildings is commonly known as the "CNX System of Wiring." The opposition to general approval of this method has heretofore, without question been based purely on commercial reasons.

Granting that this particular opposition to the material is perhaps understandable under some conditions, it loses all consideration under conditions in which practically all of the available supply of copper and rubber is needed for direct defense projects and every ounce left over finds an eager and ready buyer.

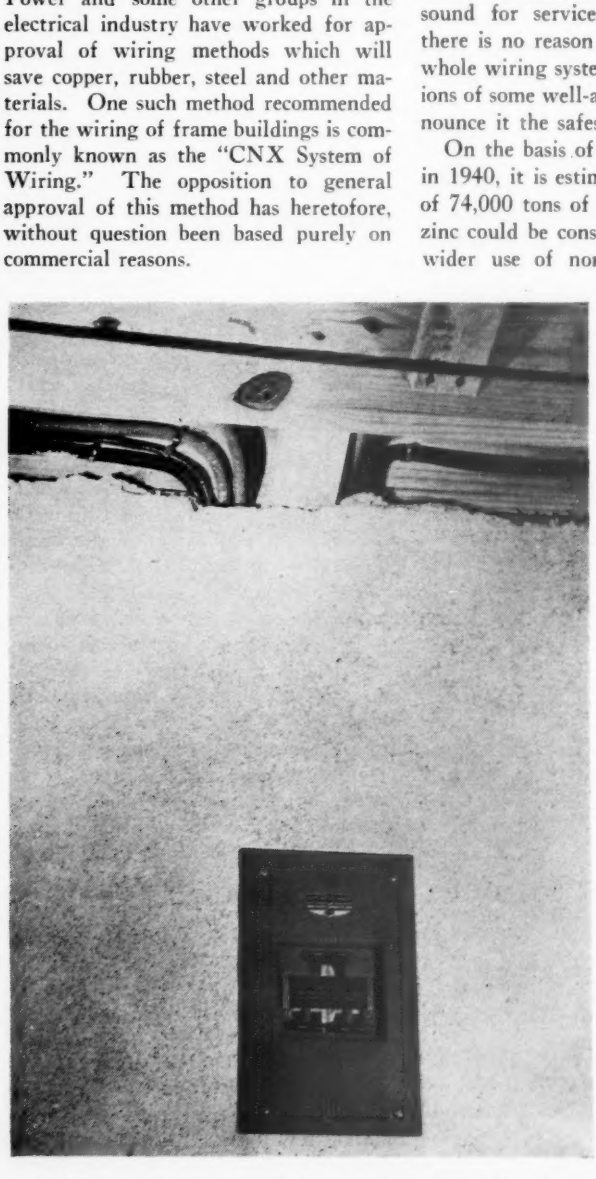
From a safety and technical viewpoint there can be no sound basis for opposition to the approval of the "CNX Wiring System." It is, in fact, already approved for trial installations and the principle used in the CNX System also has general code and field approval for a portion of the wiring system. If it is considered to be fundamentally safe and technically sound for services and range circuits, there is no reason to question it for the whole wiring system. The studied opinions of some well-advised authorities pronounce it the safest method available.

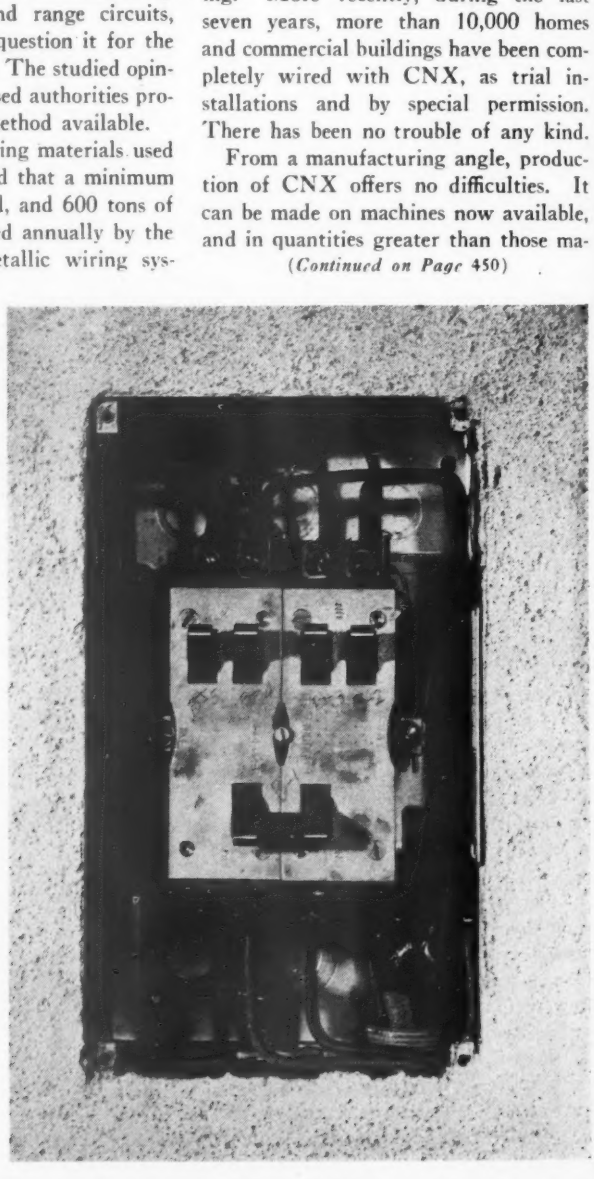
On the basis of wiring materials used in 1940, it is estimated that a minimum of 74,000 tons of steel, and 600 tons of zinc could be conserved annually by the wider use of non-metallic wiring systems where they are technically appropriate. And if the CNX system of grounded neutral wiring were used, at least 1400 tons of crude rubber, as well as large quantities of other strategic materials such as zinc oxide, used in insulation, could be considered for more vital purposes.

Use of the "CNX Wiring System" is not without precedent. One of the earliest wiring systems employed in large cities of the country was the prototype of this more modern development. After more than 50 years, many buildings so wired are in use, and have experienced no trouble or other difficulties with wiring. More recently, during the last seven years, more than 10,000 homes and commercial buildings have been completely wired with CNX, as trial installations and by special permission. There has been no trouble of any kind.

From a manufacturing angle, production of CNX offers no difficulties. It can be made on machines now available, and in quantities greater than those ma-

(*Continued on Page* 450)





With non-metallic sheathed covered neutral cables there is sufficient wiring space in this circuit breaker cabinet for seven two conductor and four three conductor circuits.

The "Last Full Measure of Devotion"

By F. R. Phillips

President, Philadelphia Company and subsidiary companies

An address before the Pennsylvania Electric Association at Bedford Springs

WE are citizens of a great nation. A nation having the greatest political, social, economic, and spiritual influence in the world today. A nation comprising a population of 130 million fellow citizens of yours and mine, having definite responsibilities and obligations as citizens of a great nation.

In times of peace, of political and social tranquillity, or of economic security, we are prone to forget our personal responsibility and obligation to our form of government and its fundamental aims and purposes. It is of such things that I wish to speak to you tonight.

With due reverence to the memory of the immortal Lincoln, I quote excerpts from his memorable address at Gettysburg. What he said then is perhaps more important to this nation and its people, and therefore to you and me, in this critical hour of our country's history than it was eighty years ago.

I quote: "Four score and seven years ago, our fathers brought forth upon this continent a *new nation, conceived in liberty* and *dedicated* to the proposition that all men are *created equal.*"

When the founding fathers established this government upon that precept, they assumed the obligation for themselves and for posterity to preserve this fundamental ideology at whatsoever sacrifice.

It is axiomatic and inescapable that privilege begets equivalent responsibility.

Under this concept of government there developed upon this continent the most successful system of free enterprise known to history.

Under this concept of government, with its guarantees of freedom of speech and of the press, freedom of religious activity, freedom of peaceful assembly, the right of petition, and the reservation of all other rights to the people not specifically delegated to the government, this nation has become the richest and most powerful in world history. Its citizens enjoy the greatest personal freedom, the highest standard of living, the greatest economic security of any people on earth. The United States of America has become the dominant factor in the arts, sciences, literature, and world culture.

This new order has been developed upon the simple but fundamental concept that *"all men are born equal,"* and that the *"will of the people is supreme."* These United States are a compact and closely united commonwealth of nations with harmonious forms of government by and through which the will of the people may be promptly consummated; a government of laws, and not of men or small groups of men.

However, in the past fifty years or more, a plague has come upon us. Characteristic of plagues, it had its origin upon the continent of Europe, and has spread gradually westward. For lack of a more descriptive term, I call it the plague of pressure groups. They are found in all branches of human activity —political, social, and even religious. It appears that no people, no government in the world is immune from its ravages. Its chief weapons are coercion and intimidation, both primary elements of physical force. Its final effect is death to personal liberty, the confiscation of property, economic, social, and political slavery.

It comes upon us stealthily. In its incipient stages, it is hardly recognizable. Its development is insidious and gradual, like cancer, and the final effect is just as deadly. An examination of the causes leading to the conditions now existing in Europe will bear testimony to the truth of these statements. You are as familiar with them as I. Those who run may read.

I shall not recount the heart-sickening details of the progress of this disease in Europe today other than to express deepest sympathy for the millions of women and children and other innocent people who are suffering indescribable agonies and facing even worse. Human beings, if you please, who, under our concept of government, should possess "the inalienable right to life, liberty and the pursuit of happiness."

Many here may say that the plague will not become epidemic in America. The people of this nation are too strong, too intelligent, too resourceful, too independent, and too vigilant to permit it. Well, are we? That is the question which I would have you deeply ponder.

At the risk of being called an alarmist or worse, I make bold to point out to you certain symptoms which to me are extremely portentous.

History has an uncomfortable habit of repeating itself. Many who are still young enough to recall school day history will remember the Rome of two thousand years ago. Rome ruled the world then. Its system of government was the new world order of that day—the first great experiment in democracy, and its citizens enjoyed practically all of the liberties guaranteed under our constitution. But the plague of pressure groups fell upon her, and ere long Rome fell upon evil days, and great was the fall thereof, for the citizens of Rome never again recovered their liberties.

May I quote excerpts from the writings of a great world historian, written a generation ago describing conditions in Rome in those days.

"War stained the imperial horizon; Goths, Alemannae, the Visigoths, and the Vandals (political parties) had emptied the treasuries. The cream of youth was being conscripted; armaments devoured men's savings; taxes were exorbitant; bureaucracies multiplied; there were unreasonable tributes, heavy armaments, and war debts.

"Industry was decadent; guilds and labor unions were striking constantly. Commerce had met with a crisis. There was inflated coinage. There was giddy augmentation of prices, and it became impossible for the poor to buy. Men lived on government doles. The common people were in despair. Everywhere were chaos, unrest, and hunger." And then the writer prophetically continued, "It was on such a day that the Star of Bethlehem rose."

Sounds familiar doesn't it?

Again, Dr. A. V. Compton, one of the world's great scholars of the present day, significantly said, and I quote: "While there has been tremendous progress quantitatively, through invention and scientific research, there has been little qualitative advancement, morally or spiritually, in the past two thousand years." Many of our great scholars, and noted students of history or political science agree with him.

To me this means that moral and spiritual values are decadent, and that the Golden Calf of Materialism is being moulded into the God of our deliverance.

Newspaper columns teem with daily accounts of the growing lack of respect for law, order, and common decency. Thinking men and women everywhere are gravely concerned at the seeming indifference for the simple virtues and moral standards of the founding fathers.

The indescribable bestiality, brutality, and pitiless slaughter of "scores of thousands of noncombatant men, women, and children on the other side of the Atlantic" is but a natural consequence of the loss of respect for the rights of others, and the practice of the simple virtues of decency and honor, and the climax of the plague of pressure groups.

It is but natural that the thought should come, "how soon shall we, too, be drawn into this maelstrom of 'blood, sweat, and tears,' the ultimate of which may well be starvation, disease, and death?"

Which is the more important to you, my friends and fellow-citizens, the highest attainable efficiency in the conduct of your profession, or the safeguarding of those precious liberties for which your fathers and mine gave "that last full measure of devotion," and passing them on to our children and children's children, unblemished, unsullied, more meaningful than ever before?

What shall we do, citizens of America? Have we, the beneficiaries of the sacrifices of the founding fathers, so soon forgotten? Have we forgotten the terrible suffering during that memorable winter in 1777-78 at Valley Forge? Have we forgotten the carnage at Gettysburg, at San Juan Hill, or the Argonne? Shall we fail, through apathy, indifference, lack of courage or understanding of our responsibilities and obligations, to honor, uphold, and defend the principles for which these men so nobly died? Shall we continue to be smug in our self-complacency and false sense of security and let the rest of the world go by? Shall we, as Assistant Secretary of War Patterson put it the other day, "contribute a worn-out frying-pan" and consider that we have discharged our obligations? Shall we calmly observe the flouting of governmental authority, the lack of respect for law and orderly procedure, the appalling growth in youth delinquency, and pass it by with a simple shrug of the shoulders?

Well, remember this, my friends: No government can guarantee security, be it political, social, or economic. The people alone have that power. No government, however beneficent, however capable, however strong, can long endure without effective and vigilant support of all its people. Corrupt government is corrupt only to that degree to which its people are apathetic, indifferent, irresponsible, or themselves corrupt. These truths are indisputable.

We of this industry, and particularly we of the great Commonwealth of Pennsylvania, the cradle of liberty, owe to the people whom we serve a higher obligation than the mere rendering of a public service. It is the people who shall preserve our liberties and determine the future destiny of our concept of government.

I know that what we say here will soon be forgotten, but shall we forget what they who gave "that last full measure of devotion" did here—"that, under God, government of the people, by the people, and for the people shall not perish from the earth."

This is the challenge that faces all true Americans.

Oh, I say to you, as did Milton in "Paradise Lost," with all the sincerity and emphasis of which I am capable:

"Awake, arise, or be forever fallen."
"Arm the obdured breast with stubborn patience as with triple steel."

Or, as a noted divine puts it:

"Be strong.
We are not here but to play, to dream, to drift;
We have hard work to do, and loads to lift;
Shun not the struggle, face it; 'tis God's gift.

"Be strong.
Say not 'The days are evil. Who's to blame?'
And fold the hands and acquiesce, O, shame!
Stand up, speak out, and bravely in God's name.

"Be Strong.
It matters not how deep, intrenched the wrong,
How hard the battle goes, the day how long;
Faint not, fight on. Tomorrow comes the song."

Yes, my friends, stand up, speak out, be brave, while you may, or God forbid, it may come to pass that we, too, may suffer the same fate of those brothers, if you please, who are dying by "scores of thousands" this very hour, and for what? For the preservation of the right to life, liberty, and the pursuit of happiness? No, indeed, they are dying and their home folks are suffering starvation and indescribable indignities because of the plague of a pressure group which seeks to impose its will upon all the people of the world.

Strangely enough, since this paper was written, while browsing through the library, I stumbled upon this bit from Kipling's "Tales of Land and Sea" written eighteen years ago:

To all to whom this little book may come—
Health for yourselves and those you hold most dear!
Content abroad, and happiness at home,
And one grand secret in your private ear:—
Nations have passed away and left no traces,
And history gives the naked cause of it—
One single, simple reason in all cases;
They fell because their peoples were not fit.

I say to you again, "Awake, Arise to your responsibility as an American Citizen. Do not be deceived by honeyed words or subterfuge. This is the land of all its citizens and not the special preserve of any political or economic group. The remedy for all these evils lies primarily within your own heart and soul, and finally in the ballot box.

And now, ladies and gentlemen, why have I spoken to you in this grave and solemn manner, at the risk of introducing a sour note into the midst of this festive hour; at the risk of personal ridicule; at the risk of being accused of lacking in understanding of present day philosophy in youth and its ideals? It is because I have reluctantly observed with deep concern the gradual abandonment of those homely, simple virtues, and the decadence of those moral and spiritual values taught us throughout the generations at our mother's knee, which are the very keystone of the arch of Christian Civilization. Which is the more to be desired—the fruits of pure materialism or the blessings of liberty at the price of vigilance and respect for the rights of others; of decency and honor, and adherence to moral and spiritual standards of Washington and Jefferson and Lincoln.

In conclusion, perhaps I can convey to you the argument in capsule form through the medium of a bit of verse from the pen of Ella Wheeler Wilcox, who, some have said, was the Edgar Guest of another day. I quote:

If I were a man, a young man, and knew
what I know today,
I would look in the eyes of Life undaunted
By any Fate that might threaten me.
I would give to the world what the world
most wanted—
Manhood that knows it can do and be;
Courage that dares, and faith that can see
Clear into the depths of the human soul,
And find God there, and the ultimate goal—
If I were a man, a young man, and knew
what I know today.

If I were a man, a young man, and knew
what I know today,
I would think of myself as the masterful
creature
Of all the masterful plan;
The Formless Cause, with form and feature;
The Power that heeds not limit or ban:
Man, wonderful man.

(*Continued on Page* 455)

The Employee and Good Will

By E. L. Bayles

Electrical Engineer, Northwestern Public Service Company

A paper presented before the company's annual manager's conference

GOOD will is a state of mind, a thought pattern, a habitual way of thinking, a group of pleasant and friendly mental associations, a feeling of well wishing, in short, the mental yea response.

A theatrical or movie producer is vitally interested in his public's acceptance of his show. He makes a careful study of the amount and timing of applause, of laughs, the overheard comments of the audience, the reactions of the critics, at the first and at succeeding performances. His show is tailored to fit the whims and reactions of his audience. A line that does not click is cut out. An actor who does not have audience appeal soon disappears from the cast. A plot that lacks interest in spite of excellent actors is soon discarded. Last, but not least, as an infallible test, are box office receipts. When his public is pleased with his production it pays—cheerfully. People wait in line to see the show. They are quick to tell others. The producer has generated public good will for his production, for his actors and for himself.

There is no easy road or set formula for this happy result. Mrs. X sits in her box and levels a critical eye on the stage through her imported opera glasses. Mr. Y sits in the second balcony and squints at the stage through a pair of Woolworth spectacles. A successful producer must please both of them and all the audience in between and do it pretty consistently if he expects his box office to thrive.

An intangible something which we may call human nature is the very sensitive ingredient which, if handled in one way produces the essence of success, and handled in another way produces the essence of failure. This is true in the show business and I am sure it is equally true in the Public Utility Business.

You, no doubt, have already in your own mind drawn the parallel intended between the theater and our own field of endeavor. We will examine parts of the comparison in more detail as we go along.

The actors on our stage are the employees. I am largely concerned with them in this discussion. They are among the principals in nearly all the dramas which count most; those involving our customers.

How they are received by our public is of vital concern to us. Aside from the minor contributing factors of the stage scenery, price of admission, etc., they are the outstanding factors determining the outcome of the performance.

I believe we have reasonably well established the major importance of our employee as the instrumentality for creating public acceptance and good will. Now let's figuratively take him apart and see what makes him tick or click, and if not, why not:

To be effective as a creator of good will, which in effect is selling the customer on the company, the employee must first be sold on it himself. This opens up at once the field of investigation, as to the questions encountered in our experience which must have a satisfactory answer before this employee's state of mind can exist:

1. *Is he satisfied with his working conditions?* This is a very broad question and may touch upon one or more of dozens of items. Focal points during recent years have indicated that more attention should be paid to wash rooms, clothing lockers, heaters in cars and trucks, safety appliances, more and better company owned tools and equipment, and improved system facilities for reducing after hour and storm maintenance activities. Demands made in our union contract negotiations indicate that irritations arise out of the handling of meals on after hour work, division of such work, holiday activities, etc. While they seem trivial to us, these matters often assume considerable importance to the employee. In the aggregate they represent his working conditions and the way in which his little problems are handled matters very much to him.

2. *Is he satisfied with his salary?* This is a tough question. Practically without exception employees have the perfectly human trait of desiring to better themselves financially. Lack of this might be considered abnormal and carry with it lack of incentive. On the other hand is this desire for better financial circumstances on the part of the employee, tempered by a consideration of his own ability, past treatment, future possibilities, permanence and security of his job, opportunity elsewhere, etc.? Weighed and examined superficially or otherwise in the light of these qualifying conditions, the question is resolved into satisfaction or dissatisfaction to some degree in the employee's mind.

We are in a particularly difficult situation at the moment of being employers in an employee's labor market. Scarcity of skilled labor and inordinately high wage scales outside our organization coupled with our limited means for meeting the differential calls for careful handling of each employee situation if possible. Plainly we cannot increase wage scales to a level with defense inflated industries. If employees stay with us then it means that probably other factors have entered largely into their decision to remain. While it must be remembered that many such employees decisions are not the result of clear reasoning, in the main they are reached with some facts and a large share of personal feeling contributing. The employee's personal feelings may include company loyalty and loyalty to his immediate employer whom he feels has made a conscious effort to keep his salary up as well as he reasonably could. Evidence of unwillingness to do reasonably well by deserving employees on salary many times tips the scales in favor of employment elsewhere when this sort of test comes.

3. *Is he in good health?* This seemingly personal problem is a very vital one to the employer-employee relationship. Relatively few employees carry any health insurance. Their sensitiveness to the Company's treatment of them during sickness or ill health is evidenced by the stress layed on the sick leave provision in union contracts.

Equally indicative are the instances of an employee's unusual gratitude and loyalty to an employer who is considerate and takes a personal interest in the employee's case of illness and associated problems. Closely related are the problems of work poorly kept up and not too pleasant contacts with the public

where a man suffers chronic ill health. These conditions do not promote happy employer-employee relations and the health factor is often given insufficient weight.

Careful choice of employees and a personal interest in them after they are hired pays dividends in this particular field.

4. *Has he or is he getting enough training for his job?* A good deal of the pleasantness of the relationship between the Company or the public and the employee hinges upon his training for his job. Were we able to go to the labor market and purchase and pay the price for thoroughly trained and competent men to fill jobs without any complications of labor turnover, etc., the path would be relatively smooth. Because of our lack of means, because of the shortage of such labor, because of our peculiar operating conditions, because of labor turnover and because of the necessity of advancing and building men in our organization, we are under compulsion to initiate and maintain training of a sort for every employee from the time he reports for work until he leaves. Recognition of this with a realistic effort to promote the employees training for his job is a step in the right direction. Trying to fit a man into the best job for which he is qualified is another step and is one of our constantly recurring problems. In these times our replacement program of necessity is pretty largely one of adding new men at the bottom and advancing qualified men into vacancies whenever possible. This makes it doubly important to look to their choice and training carefully. An unwise promotion which must be reversed does not help to sell the reversee on the company.

5. *Does he get friendly council on his problems, both business and personal, if he asks for it?* A deft touch and unlimited wisdom is required by a manager, to know how, when, what and how much advice to give to an employee. Troubles are encountered by one who advises freely on anything from investments to domestic quarrels. In equal jeopardy is the one who puts the employees strictly on his own and takes no steps in offering advice until matters are beyond control. Undoubtedly a healthful and friendly relationship can be stimulated between company and employee by the judicious offering of advice when the situation calls for it. It is practically a necessity sometimes but should be in no instance, carried to a point of paternalism.

6. *Does he possess sufficient insurance, participate in the pension plan and, in general, order his personal affairs so that he has some sense of security and confidence in the future?* Out of a lack of these secure financial habits and reasonable conduct of the employees personal business arises the stage setting for dishonesty with the Company or customer, unpleasant domestic situations, unsound habits in handling Company business and financial worry. Corrective measures are sometimes obvious and sometimes very difficult. Company-employee relationships will be more pleasant however, with this factor taken into account.

7. *Is his home life adjusted and his wife satisfied with the Company relationship and location so that she is an asset to him and to the community?* This is a spot where angels fear to tread. We definitely must recognize this however as a prime factor in the success of an employee in his job. It is of major consequence in the relationship with the company as well as the public. It might be suggested that in instances where it is of most importance as in key positions and Town Superintendent posts the employee and his family be considered as a team and their possibilities weighed as such before locating them. Efforts should be made to have Company wives informed of Company activities and problems and to feel that they are a part of the Company family. Enough illustrations have come up within the past few years to make us realize that the better half can either make or break the employee. We only recognize the situation here. We know of very little we can do about it.

8. *Does he have intelligent and friendly supervision?* In companies with scattered territory supervision becomes very thin. In many instances it is very apt to reach the vanishing point. With experienced employees this is bad enough. With the novices becoming more prevalent in some organizations it becomes an acute problem. There is little time to stop for explanations and detailed orders. Tempers are apt to be shorter and commands more curt. Assumptions will be made that the man understands when he doesn't. Ignorance will be mistaken for carelessness. The fruits of such a situation include misunderstanding and unpleasant relations between the Company and employee. It calls for more and more personal supervising on the part of management and all key men, with more than a small portion of patience. The employee's success and to a great extent, his safety, depends greatly on the amount and quality of this supervision.

9. *Is he a good citizen outside of business hours so that the consequences of his after-hour activities do not complicate his company or business relations?* Considered by many to be none of the Company's business, this question over the years has caused the employer-employee-customer relationship more rough going than a great many supposedly more important considerations.

Careful first choices with alert supervision and judicious advice before incidents become habits may be at least, an approach to answering this question. We are supposedly buying the labor or services of a man but good, bad or indifferent, we are obliged to take his personality, habits and general conduct along with it, and to lose or gain thereby.

We have talked so far about the employee being sold on the company himself. Also directly concerned with his success as a good will instrumentality is the necessity that the Public be sold on him.

A producer spends thousands of dollars on building up an actor, for a purpose. A name, prestige, gives the actor a running start with his public. The customer would much rather do business with the manager of a business than with a flunkey because it tickles his vanity a little. Our employees cannot all be managers but they can be given the kind of support in customers' dealings that lends dignity and respect to their particular station whether high or low. Some suggestions which may help in selling the public on the employee are:

1. Local business and contacts should be handled through the local representatives of the Company wherever possible to help their building-up or prestige. Do not go over their heads if it can be avoided.

2. Allow and encourage an employee first contacted by a customer on a problem to carry the matter through to a conclusion with all the help he needs to do a good job if such procedure is at all practicable.

3. Encourage every tendency on the part of the employee to participate in civic or community activities which will bring him wider local acquaintance and acceptance, within reasonable limits of the man's time, ability and means.

4. Do not limit efforts at employee buildup to key personnel only. The lowliest employee may be the standard by

which his circle of friends measures the company or through whose eyes they see the company's policies.

5. Make sure the employee does not have one attitude and grade of service for the elite strata of customers and an entirely different one for the common or sub-standard individual.

6. When mistakes are made on a customer's job an opportunity should be given if possible for the employee who erred to correct the situation and clear himself with the customer, giving him whatever help is needed. Definitely bad is the effect of the "expert" who goes out to clean up the mistake and leaves the impression that the first employee was "just a kid and didn't know any better."

A complimentary requirement beside the man being sold on the Company and the public being sold on the man is that the Company be sold on the man. He will be more effective if the Company stands back of him and lets both employee and public feel the Company's confidence.

Many misunderstandings of a man's ability arise out of a lack of sufficiently close acquaintance and actual study of his work. We often do not have all the facts before we pass judgment.

Unfairness in estimating the value of men occasionally arises because our estimates are not elastic but are based on some impression obtained in the past and never revised to take into account the man's improved ability due to study, experience and, we hope, through supervision. Our conceptions of men must be under continuous revision in the light of continuous observation to be realistic and fair.

The Company should be willing to take all reasonable steps to improve men to the point where the shortcomings are corrected and they are finally sold on the man.

Having looked at our public, employee and company in the roles of audience, actor and producer, let's have a look at the plot or scenario. This, our actors must have or their activities are meaningless. Are our company's policies and operating practices suitable to lend purpose and gain results through the instrumentality of our employees?

Management's obligations in the formation of policies may include among other things that they be:

1. Objective with relation to Public Goodwill;
2. Practical in application;
3. Understood by employees.

The employees performance must be directed by a supervisor which should take these approaches in directing:

1. Operation on a basis that no employee is a "finished performer." This, however, should include limits in direction and criticism short of destroying initiative, with unstinted praise where it is due.

2. Instructions or orders with some explanation are more effective than outright commands.

3. Supervision should be delegated to a reasonable extent but never completely.

Best utilization of our employees and the best performance with them comes when they are all interested in growing more efficient in their various parts of the whole activity. Our employee will have a greater enthusiasm, a keener edge if he is preparing and training for something better. Management might bear in mind these suggestions:

1. Encouragement should be given to education of all employees.
2. Never be held back by a fear that some day an employee will know more than the boss.
3. Make employees feel free to ask about the company's business and to learn about other departments.
4. Create the feeling that advancement is limited only by ability and effort and that learning to do the job better pays.

Public Ownership is putting on a show and a very well advertised one. They are drawing crowds and have some heavy financial backing. On our side of the street we have producers and actors that are tried and true. The test comes in the kind of show we put on. Can we give our public what they want? I think we can.

It Looked Harmless

From Just Looking Around, By John Read Karel in The Kewaunee (Wis.) Enterprise.

ON OUR DESK is a small piece of hair-like wire. It looks as harmless as a horsehair or a piece of thread. But last week a length of this same wire almost took the life of a 9-year-old boy in Door county.

* * *

SOME YOUNGSTERS were playing with an old radio coil or transformer. One of them uncoiled some of the wire and, just to see what would happen, threw it over a 2,300-volt power line. Little Wallace Kracht of East Maplewood, playing nearby, ran against the almost invisible wire. It brushed against his temple, burned off and knocked him unconscious. He didn't die, but if that wire had been just a little thicker death would have been instantaneous.

* * *

THE WISCONSIN Public Service Corporation sent us this bit of wire, just to show what little things can make big headlines. And as we looked at it, wondering at the lethal power of electricity, it dawned on us that the utility corporations of this country deserve a little credit for their work in "electrocution prevention."

* * *

FOR YEARS we have been reading Public Service advertisements about the danger of fallen and dangling wires; about the sudden death that awaits youngsters who fly kites near power lines. We have seen educational posters, sent by these utility corporations into the schools, to teach children that electricity is deadly and dangerous. These lessons have given us a wholesome and justified respect for electrical power. And in addition to these educational measures, Public Service and other utilities maintain rescue squads, pulmotors and trained workers, ready at a moment's notice to help save the lives of those who forgot their teachings.

* * *

PUBLIC SERVICE manufactures a product . . . electricity. The big difference, it dawns on us, is that Public Service doesn't just throw its product on the market and forget about it. It places every possible safeguard about its distribution; it teaches us how to enjoy electricity without the risks; it has, at enormous expense, trained whole generations to respect electricity and recognize it as a wonderful servant which must be kept under control lest it revolt and kill its master.

* * *

THIS, my friends, is done voluntarily by what you and I are too often prone to call a "heartless corporation."

Direct Comparison Leads to Direct Mounting of Pole-Supported Transformers

By Frank Sanford*

Distribution Engineer, Cincinnati Gas & Electric Co.

Presented at EEI Transmission and Distribution Committee meeting, Cincinnati, Ohio, Oct. 20-22, 1941

IF the idea of hanging transformers on poles had been proposed just recently, there would be general agreement, almost without question, that the units should be bolted to the poles. We would hardly take less security, and at the same time go to the added expense of bolting hangers to the transformers; to be, in turn, hooked over wood crossarms; which are, in turn, bolted to the poles.

With the simpler alternative selected, we would want to have two supporting bolts, with spacing and arrangement uniform, so we would not need to drill one or two new holes each time the transformers are changed. We would, of course, want tests made to check the strength, and resistance to vibration and sudden shock. Joint study and efforts of representatives of the utilities and manufacturers would be expected to lead to a degree of standardization and uniformity of parts and installation practices.

Actually these alternatives were not presented and the custom grew of using crossarm hangers, even though everything else on the pole has been securely fastened to its allotted space. In the earlier days, when the practice started, there were no high-speed automobiles and trucks to jump curbs, road shoulders, and ditches, to push the poles to rakish angles or break them off.

The only point that has been standard in the design of transformer mountings has been the idea of having hooks bent at the upper ends of two hangers. Shape of the hangers, size, mounting hole dimensions, length above or below the transformer case, and distance from case to pole, have each varied over the widest possible range. These variations have been not only among manufacturers, but among styles, sizes, and years of any one manufacturer.

This has been reviewed in detail before, and all warehouse and installation crews are thoroughly familiar with the troubles that are incidental to fitting replacements for the hangers. By itself, however, it was not considered a major item for action by industry committees.

Trend Toward Direct Mounting

There has been a gradually developing trend toward a standard direct mounting arrangement.

Some companies started using individually designed direct bolted adapter plates to replace the hangers, following the experience of having transformers knocked off the crossarms.

Other expedients included a bolt through the hanger hooks, and straps around the arms and hanger hooks, to prevent the hangers being unhooked from the arms.

For heavy transformers, it was found necessary to reinforce the wood crossarms by using steel channels or angles bolted to the poles, to support the hangers.

Many rural construction standards dropped the use of crossarms, pole top pins and brackets being used to support the conductors. With less precedent and no crossarms, rural service type transformers have been quite generally bolted to the poles.

Standards Adopted

The first report of a joint committee representing users and manufacturers of distribution transformers was published in February, 1940. That the surveys, studies, and tests back of this report met with approval, is shown by the present almost unanimous availability and acceptance of transformers listed as EEI-NEMA Standard. Voltage ratios, taps,

* Member EEI-NEMA Joint Committee on Standards for Distribution Transformers.

Time-honored method for support on crossarms. The kicker strap is of recent origin to replace short crossarms formerly used to hold the bottom away from the pole.

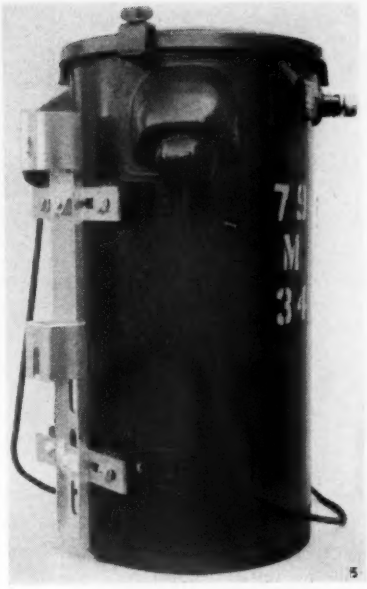
Standardized hanger and kicker of the new EEI-NEMA Joint Committee design, for use where crossarm mounting is continued. Hanger and kicker are accessories.

New standard mounting lugs for direct-pole mounting are to be furnished on all new transformers.

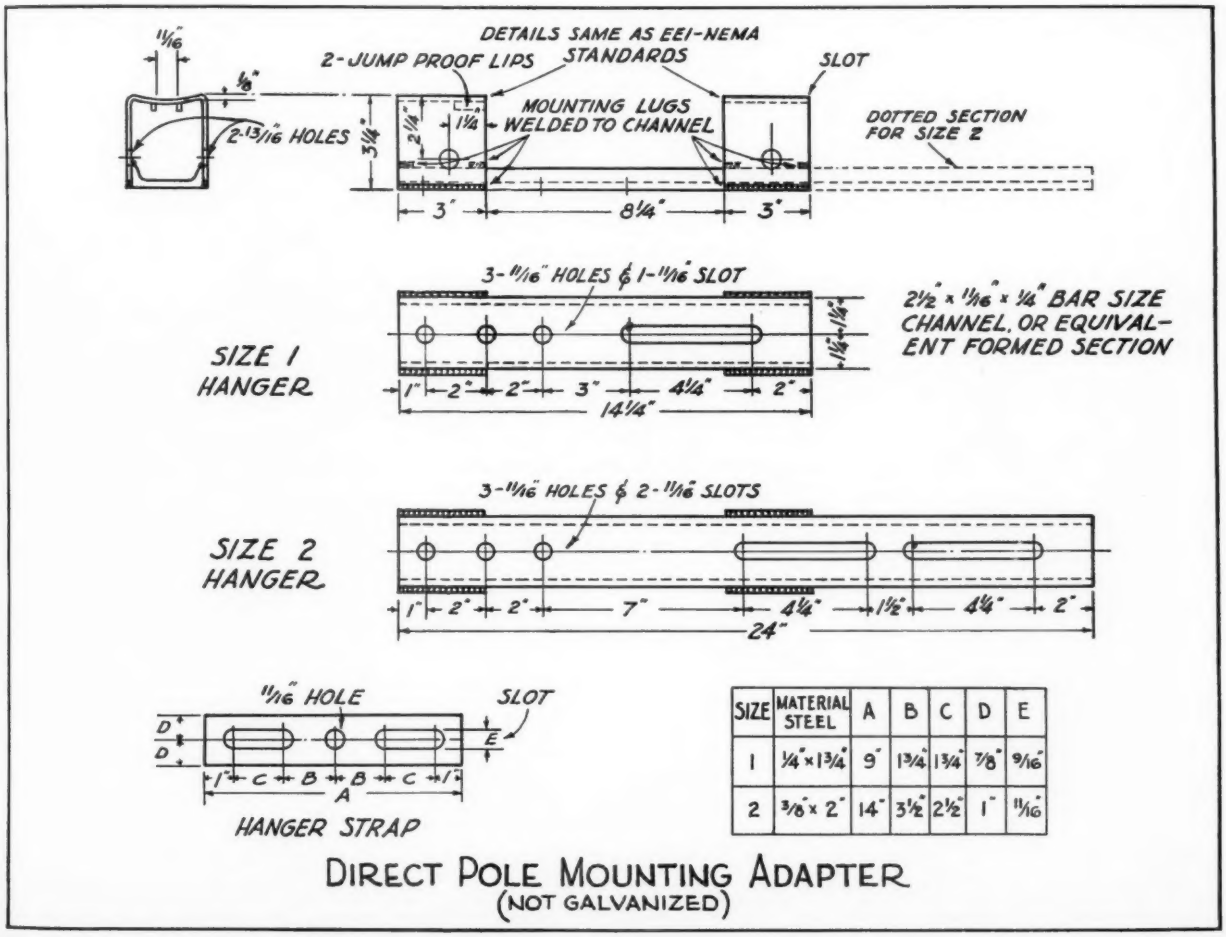
connections and connectors, bushing arrangement, and direct mounting support lugs for sizes up to 25 kva were covered in the first report. With a second report to be released January 1, 1942, for up to and including the 100 kva unit, all of the transformers in the usual group of pole-mounted sizes are covered in the Standard.

For users not ready to make the change from crossarm mounting, an adapter designated as a "T-hanger" was adopted. With this hanger, a "kicker" may be used to hold the bottom of the transformer in line with the top support. The kicker may be used without the hanger where mounting on the double crossarm through-bolt is desired.

These three possible methods of mounting are available with standard items of hardware, and a maximum of construction flexibility is provided. With adoption and acceptance of these standard items and dimensions, the transformer prices have been adjusted to reflect these changes. Transformers with

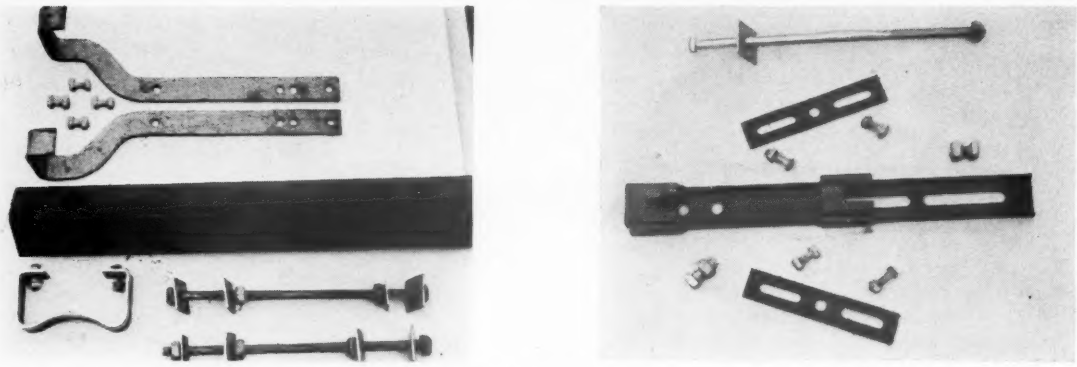


An adapter plate hanger that fits the older style transformer support lugs to give pole mounting same as new transformers.



SIZE	MATERIAL STEEL	A	B	C	D	E
1	¼" x 1¾"	9"	1¾"	1¾"	⅞"	9/16"
2	⅜" x 2"	14"	3½"	2½"	1"	11/16"

DIRECT POLE MOUNTING ADAPTER
(NOT GALVANIZED)



Accessory material for installing transformer with mounting lugs as provided before EEI-NEMA Standard; left, with crossarm hangers; and right, with adapter for direct pole mounting.

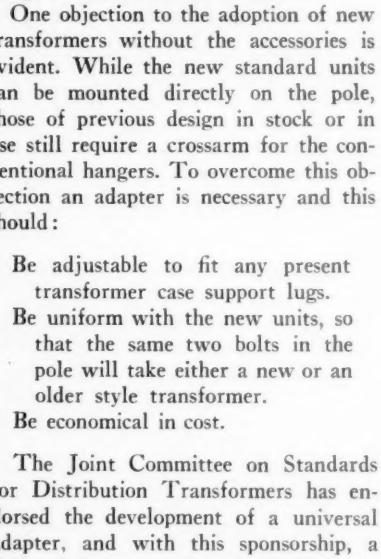
support lugs are basic items, and the hangers and kickers are accessories.

One objection to the adoption of new transformers without the accessories is evident. While the new standard units can be mounted directly on the pole, those of previous design in stock or in use still require a crossarm for the conventional hangers. To overcome this objection an adapter is necessary and this should:

Be adjustable to fit any present transformer case support lugs.
Be uniform with the new units, so that the same two bolts in the pole will take either a new or an older style transformer.
Be economical in cost.

The Joint Committee on Standards for Distribution Transformers has endorsed the development of a universal adapter, and with this sponsorship, a design has been prepared as shown in the accompanying drawing and illustration. It is now available as a hardware item from several manufacturers. Experience with its use indicates that, with only a few exceptions, it will fit all transformers in the 2400-volt class, up to and including 25 kva. A check of several manufacturers' dimension records shows that it can, in general, be used for the whole group of sizes covered in the Joint Committee report, for 12-inch bolt spacing.

A similar design has been made for transformers to be mounted on 24-inch bolt spacing. For the present, shop-built hangers are being assembled by welding old hanger iron material to individually fit. These have 24-inch mounting bolt spacing, in line with the EEI-NEMA Standard for larger transformers.



A fairly common sight if any transformer repair shop. A few fall, and others continue to hang by one hook or the leads.

Economy of Direct Mounting

It is apparent that no great percentage of investment or operating cost is involved in an individual decision between continuing customary crossarm hanger mounting and changing to direct pole mounting. Here again, however, as in other decisions regarding distribution line practices, we should remember to multiply the small difference by the number of thousands of units involved.

For the Cincinnati Gas & Electric Company distribution system, several considerations have led to a complete change to direct mounting, for all new and repaired transformers to be installed. For construction used in Cincinnati:

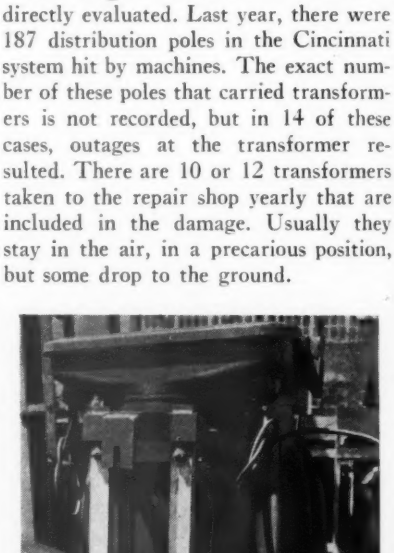
1. The estimated unit saving for new transformers in new installations is $3.85 for the sizes 25 kva and below.

2. For the older transformers, equipped with adapters in the repair shop, the saving for the crossarm and bolts will pay for the new hangers and the cost of changing them.

3. For larger installations of new transformers, where we have in the past used channel reinforcement, the saving will be $8.50.

4. For the larger sizes with shop-built adapters, there is an average saving of about $4.00.

The largest consideration cannot be directly evaluated. Last year, there were 187 distribution poles in the Cincinnati system hit by machines. The exact number of these poles that carried transformers is not recorded, but in 14 of these cases, outages at the transformer resulted. There are 10 or 12 transformers taken to the repair shop yearly that are included in the damage. Usually they stay in the air, in a precarious position, but some drop to the ground.



A shop-made, individually-fitted direct mounting hanger for larger transformers. Spacing for mounting bolts is 24 inches, same as for large EEI-NEMA Standard transformers.

Maintenance and Its Effect on Depreciation Reserves

By Leonard V. Smoot

THE study of depreciation of a utility offers a field that is wide open to the engineer. The cause is known, the effect is known, it is only the rate at which depreciation may result that remains to be solved. Depreciation does not accrue at a constant rate throughout the existence of the equipment. It is influenced, among other things, perceptibly by the rate of maintenance, which in turn is dependent on the economic conditions encountered. To omit maintenance from any depreciation study is to overlook the most prevalent cause of error in setting up any rate of depreciation either constant or variable. The level of maintenance changes with the financial status of the company, that is, when times are prosperous, maintenance is low and replacements are high, and the converse is true for periods of adversity. The effect is to shorten the life of the equipment in one instance and to prolong it in the other.

In any such accounting where maintenance is ignored the permanance of the company is forgotten. Reserves for retirements are being influenced by the sinking fund idea in which the debt is to be liquidated in a definite term of time, yet all evidence indicates that this should not be the case.

Every piece of equipment is installed for permanent use and the accounting record should be made to reflect this permanence with periodic replacements from any cause whatsoever. The causes of replacements, however, should be legitimate, and the cost should be applied against those benefitted.

However, to pursue the idea of maintenance we shall drop the subject of cause for the moment.

The rate at which depreciation accrues is proportional to the time of service. In like manner the rate at which maintenance must be applied is proportional to the amount of depreciation accrued. These two facts may be set up mathematically as follows:

(1) $\frac{dv}{dt} = rt$ where y is the depreciation and t is the percentage of whole life involved.

(2) $\frac{dx}{dt} = ky$ where x is the maintenance and t and y are the same as in equation (1).

From these equations it is evident that depreciation is proportional to the square of the time, and that maintenance is proportional to the cube of the time. Both of these deductions are reasonable and are attested by facts that the older the equipment the more expensive its maintenance becomes, and the faster it depreciates in value. At some stage it is no longer economical to continue maintaining. However, it is not beyond the realm of reason that any article may be maintained indefinitely so that its rate of depreciation is considerably changed. For these reasons it is a hopeless accounting task to separate the two accounts and expect to depict accurately the actual change in value of equipment in its physical aspects.

In order to set up reserves for maintenance and replacements many of the ideas prevailing would have to be discarded. Any thought of the reserves in terms of a sinking fund must be forgotten.

In order to form an intelligible idea of reserves for depreciation and maintenance, the assumption must be made that the utility is *permanent* and is to be *permanently maintained.* Investments in the property are to be perpetual and not to be retired under any condition. This attitude immediately gives the reserve accounts a different aspect from that previously held. With this idea in mind the amount in the reserve account will be a measure of the level to which the property is maintained, but will not indicate its value as recorded.

The amount of the reserve should not be more than adequate to maintain and replace equipment at the average level at which it is desired to keep the property. This tends to simplify rate making to the extent that a fixed amount can be allotted out of earnings to perpetuate the plant. If as in abnormal times, more or less is spent on maintenance, then its complementary account, replacements, will fluctuate accordingly.

The amount to be set aside would be determined not so much on the basis of capital investment as upon the rate of turnover of equipment and the economical conditions imposed by maintenance.

Assuming that it is desirable to maintain the plant at a level of efficiency now existing, the total amount to be set aside for replacements and maintenance would be the amount now being spent for these two items.

There is no measuring device known that will evaluate the term of life of any part of a utility, and likewise in a plant that is growing continuously as a utility, there is no method by which the average life of the plant can be calculated. To assume an average life would be an error that would penalize either the customers or the investors. The amount of reserve for replacement and maintenance should be determined much in the same manner as a cash reserve is maintained in banks. It should be adequate to take care of the demands upon it without embarrassment to anyone.

To return to the two equations deduced earlier it is evident that neither of them is a straight line nor is their sum a straight line. Both of them are segments of a curve, the slope of which increases from 0 at the origin to a maximum when $t = 1$ as maximum life is obtained. The amount set aside in the reserve account would be the addition of these two and the ratio of this reserve to the total plant investment might be construed to represent the average age of the plant. Thus reserve divided by capital investment would represent t in the equations. Then t^2 would be the actual depreciation and t^3 would be the actual maintenance represented. However, maintenance should lose its identity as such at the end of each accounting period and any part of the reserve not used in that period for maintenance would become a reserve for replacements in its true sense. Then t^2 is truly the actual depreciation. In this example if the ratio of reserve to capital investment were found to be .25 the actual depreciation will be .0625 and the plant condi-

tion will be 93.75 per cent. Likewise the rate at which maintenance funds would be accumulated for such a condition would be 1.5625 per cent of the investment.

All arguments here are based on the assumption that any rate assumed for building up the reserve has been arrived at intelligibly, and that an honest effort has been made to reflect truly the conditions imposed upon the accounts. If the amount in the reserve accounts is adequate it will be a true measure of the actual depreciation of the plant, as pointed out before. It will be a fallacy to assume that the amount in the reserve account represents actual depreciation because the difference between the reserve for replacement and actual depreciation is found to be $r(t - t^2)$ where rt is the straight line accumulation rate and rt^2 is the actual depreciation rate.

It is impossible to predict the life of the equipment now in use from any experience with equipment in the past as long as inadequacy and obsolescence are included in depreciation studies. True these are sufficient causes for replacements but to try to anticipate their effect and to try to account for them in any reserves for replacements is to induce an error immediately into the accounts. The user is vitally affected if he is charged rates that include these items promiscuously.

Any replacements because of inadequacy or obsolescence should be paid for by those benefitted and the fact that replacements have been made for these reasons should not affect past users or past owners to the benefit of future users and future owners. Replacements because of obsolescence is definitely an owner's cost, and any part of the cost of retiring equipment that is not yet worn out should be assumed by the owner as his expense. Replacement because of inadequacy is a future users expense and should in no way affect the past users expenses.

These facts suggest that it is definitely unfair to include these two causes in the depreciation studies, but that they should be isolated so that the proper course may be followed in alloting the cost to those benefitted.

In conclusion let us not forget in setting up our reserve accounts for replacements that the utility business is here to stay. It is not a business that will be liquidated at any time to satisfy its creditors. The permanence of the business is assured and the level at which we expect to maintain it is dependent upon what our customers expect of us. However, the lower level we maintain the more expensive will be the maintenance. The customer has placed certain demands on us for continuous service at the same time demanding low rates. He can have both but he must be fair in seeing that we are allowed sufficient income to maintain a high level of efficiency, and we must be fair in our handling of the business to assure our customers that every dollar he gives us is being used judiciously and for his benefit.

APPENDIX

Pursuant to the plan suggested in the general paper on the effect of maintenance on depreciation several charts and tables are prepared to show how the plan may be applied.

Chart 1 shows a symmetrical graph of replacements of units in a group in which the oldest units reach twice the average age of the group. This is a mathematical chart used only for illustration; the actual observed data indicates that the oldest units reach three times the average age of the group. This chart means very little to us because we have dropped the idea of reserves according to groups and are applying a fixed rate, not only to groups, but to units that retain their individuality, such as generators, boiler assemblies, buildings and the like. The group idea would be confined to parts of the plant that contained large numbers of individual items such as poles, transformers, and similar items.

Regardless of what happens to the group, depreciation of the individuals within the groups will follow substantially the same curve shown in Chart No. 2. There are other factors besides time involved, such as errosion, corrosion, shift, settlement, and similar causes of depreciation, but these effects are overcome by proper maintenance which we are including in our reserve. Here it must be pointed out that the rate of depreciation and required maintenance is

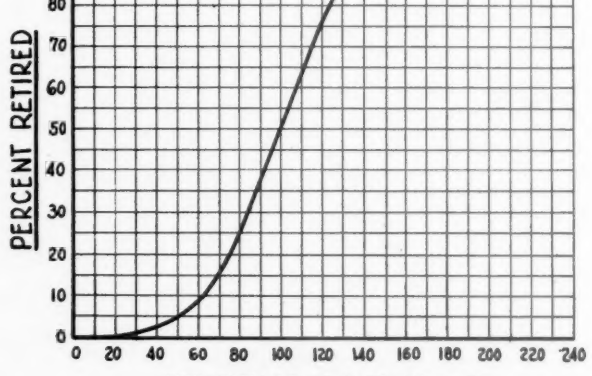


Chart 1—Typical graphic retirement chart for original group installation.

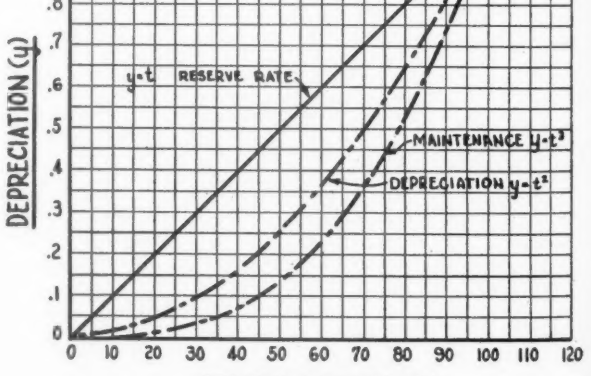

DEPRECIATION (y)
0 .1 .2 .3 .4 .5 .6 .7 .8 .9 1.0
y-t RESERVE RATE
MAINTENANCE y-t³
DEPRECIATION y-t²
0 10 20 30 40 50 60 70 80 90 100 110 120
PERCENTAGE OF LIFE(t)

Chart 2—Comparison of accumulation, depreciation and maintenance curves for individual items.

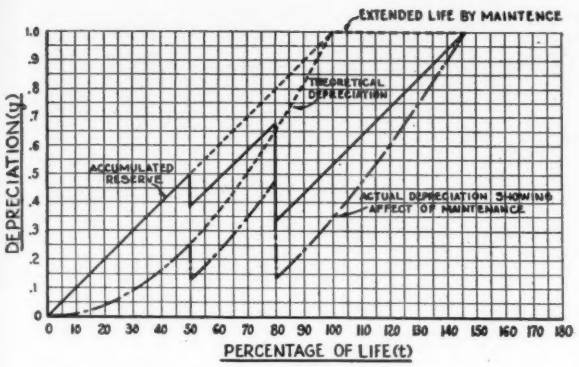


Chart 3—Affect of maintenance on depreciation for individual items.

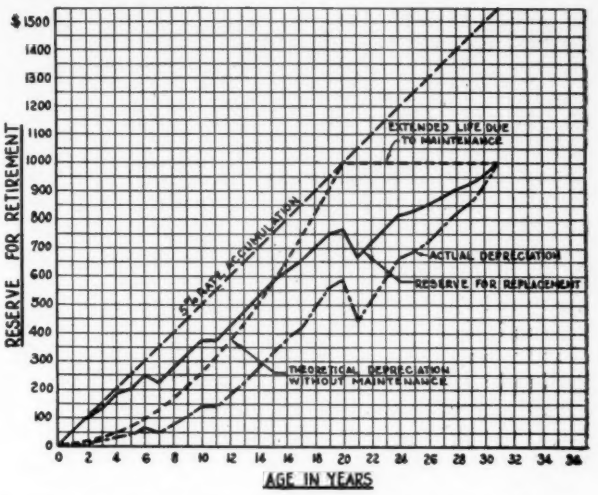


Chart 4—Graph showing relation between reserve for retirement and actual depreciation.

not the same as the rate at which the reserve is accumulated. Chart 2 shows the comparison between the three rates, and Chart 3 shows the effect that maintenance has on actual depreciation and on the reserve for replacement.

Tables can be constructed to show the accumulation of the reserve funds for replacement of the equipment. Such tables show the diminishing investment as the reserve increases until the original investment is equalled. We too have built such a table to show how the original investment will be retired, but we have shown also how the application of maintenance changes the apparent value of the equipment, or restores it to a new value from time to time, as well as lengthening its service life. Table I is such a table and Chart 4 is the graphic illustration of the results.

Whether the plant is growing or has reached a static condition, or is diminishing, will not affect the method except that in a growing plant there will be more new units, a higher rate of infant mortality, and a greater difference between the reserve for replacements and the actual replacements, than in a plant that is static in its size. The rates at which replacements are made are necessarily different in the two plants, but if the idea is followed to create a reserve sufficient to meet the needs of the growing plant, it will be sufficient to meet the needs of a static plant. In a growing plant the full life of the equipment is not realized because of plant growth; old equipment is replaced with new equipment of greater capacity long before the old equipment is worn out; perfectly good equipment is often retired because of changing conditions in the growing community. If there is any change in the rate of retirement as the plant approaches static conditions the change will be a reduction rather than an increase. No deficits will be found in the retirement reserve due to the changing conditions.

Naturally the pertinent requirement of any system of accounting will be to obtain the recommended rates for accumulating the reserve. Table II assumes to ascertain the rate at which the reserve should be accumulated from a study of the past records of capital, replacements, maintenance and additions to capital. Since the two expenses, retirements and maintenance, are to be added to obtain

TABLE I

See Chart No. 4

Accumulated Reserve and distribution to maintenance and Replacement Reserve showing effect on actual depreciation and service life of equipment.

Year	Original Investment	Rate of Accumulation	Maintenance Cost	Reserve for Replacement	Ratio Reserve to Investment	Actual Depreciation	
1937	1,000	50	..	50	.05	.0025	
1938	....	50	..	100	.10	.01	
1939	....	50	15	135	.135	.0182	
1940	....	50	..	185	.185	.0342	
1941	....	50	35	200	.20	.04	
1942	....	50	..	250	.25	.0625	
1943	....	50	75	225	.225	.0505	
1944	....	50	..	275	.275	.0755	
1945	....	50	..	325	.325	.105	
1946	....	50	..	375	.375	.14	
1947	....	50	50	375	.375	.14	
1948	....	50	..	425	.425	.18	
1949	....	50	..	475	.475	.225	
1950	....	50	..	525	.525	.275	
1951	....	50	..	575	.575	.33	Average life without maintenance
1952	....	50	10	615	.615	.378	
1953	....	50	15	650	.650	.421	
1954	....	50	..	700	.70	.49	
1955	....	50	..	750	.75	.5625	
1956	....	50	35	765	.765	.585	
1957	....	50	150	665	.665	.442	
1958	....	50	..	715	.715	.512	
1959	....	50	..	765	.765	.585	
1960	....	50	..	815	.815	.663	
1961	....	50	35	830	.830	.69	
1962	....	50	30	850	.850	.722	
1963	....	50	20	880	.880	.775	
1964	....	50	25	905	.905	.82	
1965	....	50	30	925	.925	.855	
1966	....	50	25	950	.95	.905	
1967	....	50	..	1,000	1.00	1.00	Extended life with maintenance
		1,550	550				

the rate for the reserve account, it makes no difference what the basis for the segregation of the two parts may be. As long a period as possible should be included so that the average will include both years of prosperity and years of adversity. Before 1937 many items that are now replaced through capital were considered maintenance, but since the ultimate aim is to obtain the total of these two, no error will be made in going beyond 1937 in the study. The main purpose is to obtain a rate that is sufficient to meet all requirements and to handle the accumulated reserve so that the plant is maintained adequately without burdening either the owner or the customer with unnecessary costs.

Whether the plant is retired as a unit as indicated in Table No. 1 or is retired piecemeal from infancy to old age, will depend upon the type of units being retired. The only difference is that as indicated in the two Charts Nos. 1 and 2, the average life of the group is applied in the same manner as the total life of the individual. The investment will be diminished as units are retired, but the total time involved will be at least twice the average age, which will effect an accumulated reserve sufficient to cover the cost of replacement of the entire group as required. At least 85 per cent of the reserve will have been accumulated before the first half of the units will have been retired. However, in applying the methods set forth here, retirement reserve shall be only that sufficient to meet the requirements of the plant, whether new or old units are being retired. Age of the unit is of little consequence except as it affects depreciation, which as we have shown is related to replacement reserve, is measured by it, but is never equal to it except under special conditions.

TABLE II

Indicated method for determining growth, rate of retirement and maintenance for period from 1937 to 1941, the period to which present accounting methods have applied. (All figures are Fictitious.)

Year	A Capital Investment Beginning of Year	B Additions For Year	C Retirements For Year	D Capital Investment End of Year	E Maintenance During Year
1937	1,000	40	30	1,010	18
1938	1,010	70	40	1,040	15
1939	1,040	100	35	1,105	24
1940	1,105	75	30	1,150	19
Totals	4,155	285	135	4,305	76

Net Growth %—$\frac{2\ (B\text{-}C) \times 100}{A + D} = \frac{300 \times 100}{8460} = 3.55\%$

Retirements %—$\frac{2\ C \times 100}{A + D} = \frac{270 \times 100}{8460} = 3.19\%$ Average life 31 years

Maintenance %—$\frac{2\ E \times 100}{A + D} = \frac{152 \times 100}{8460} = 1.81\%$

Total to be accumulated—3.19 + 1.81 = 5.00%

Conservation of Materials for Defense Wiring

(*Continued from page* 438)

chines are capable of producing in other types of wire. It is also possible that a portion of the production work for CNX can be done on a type of machine that quite often lies idle in the plants today.

Armored Cable with Un-insulated Neutral

Another wiring material that has some merit is bare neutral armored cable. Although it naturally has a more limited field than CNX, since the non-metallic wiring methods are generally preferred today, particularly for frame buildings, it should not be overlooked where, for some special reason, a metal clad flexible system is required. Having one insulated and one bare wire, in the 2-wire assembly, and two insulated and one bare, in the 3-wire, it is of smaller diameter than standard armored cable and uses less rubber, braids and steel. Of even more importance is the matter of superiority; the bare neutral conductor in contact with the sheath reduces the resistance of the sheath, giving positive protection against grounds and eliminating the possibility of a "hot" sheath, overcoming thereby a real hazard and the principal objection to armored cable. Furthermore, it has the advantage of adaptability, can be produced by existing machines, and installed using standard armored cable fittings throughout; can be used for new work, repairs and extensions to old installations.

In order to conserve the steel, brass and plastics in outlets as well as the copper necessary to serve them, Interpretation No. 1 of OPM's Defense Housing Critical List has limited the number of outlets in dwellings eligible for priority aid to approximately two-thirds of those used in houses that are considered adequately wired.

Wiring Defense Housing for Future Adequacies

Every effort should be made to enable builders to live up to the spirit and the letter of these necessary restrictions. Fortunately there is a happy and easy solution to the problem of providing *future* adequacy of electric outlets in defense housing.

The wiring layout and the number of outlets should be planned in accordance with liberal standards of future adequacy. Porcelain and other non-metallic outlet boxes are available in substantial quantities and are thus far unaffected by priorities, so they may be installed liberally. However, the actual wiring and wiring devices now installed should be limited to the OPM order. If the work is well planned and suitable provisions made at the time the original limited wiring is installed, it becomes a simpler matter to pull in the additional wire at some future time and connect up the remaining outlets. A piece of string run to the unused outlets will facilitate pulling in the subsequent wiring. Meanwhile, the unused outlet boxes may be closed with composition or porcelain covers.

In this way a few dollars spent at the present time in providing an adequate number of outlets will add materially to the future value of the house, and provide for the convenience of future occupants. Meanwhile, the use of non-metal-

(*Continued on Page* 471)

Revisions of National Electrical Code—1940 Edition

By J. C. Langdell

Meter Supervisor, The Commonwealth & Southern Corporation, Jackson, Mich.

Address before the Engineering and Operation Section Meeting, Southeastern Electric Exchange, St. Petersburg, Fla., Sept. 25, 1941.

MANY of you are already familiar with the 1940 edition of the National Electrical Code and the revisions from the previous edition that it contains. Some are of a minor nature but a few are far reaching in effect in the electrical industry and, therefore, of great import to operating electric utilities. It is my opinion that all operators of electricity supply systems should take more of an interest in this Code and its provisions since it can and does affect our business in many ways. For that reason, I am taking this opportunity for discussing with you several present Code requirements of major importance in our business.

Of all the changes included in the 1940 edition of the National Electrical Code, the ones in which the utility companies are most interested are as follows:

1. Grounding of Meter Enclosures

Meter enclosures, installed on the supply side of service equipment, may be grounded to the neutral conductor of the service entrance where the bare neutral is employed. (Section 2382—1940 NEC.) This provision eliminates former diversity of opinion as to whether or not this could be done and is important from a meter installation standpoint. Lack of this provision in previous Codes brought about the necessity in some locations of making connection to a ground in the meter enclosure.

2. Surge Protection in Hazardous Locations

In so-called Class II locations, which are those having atmospheres containing metal, coal, coke, carbon black and grain dusts and which are in areas where lightning disturbances are prevalent, it is required that power services be suitably protected against high voltage surges. This protection shall include suitable lightning arresters, surge protective capacitors and interconnection of all grounds. (Section 5053, 1940 NEC.) This latter provision should be of particular interest to the distribution engineers as it may affect their service practice for these cases.

3. New Insulations and Thinner Insulations for Building Wires

Editions of the National Electrical Code prior to 1940 recognized, in general, only one type of rubber covered wire designated by the letter "R." The 1940 edition now recognizes three additional general types of rubber covered wire; namely, types RH, RP and RW, and in addition, bases the current carrying capacity of the conductors on the maximum temperature attained under a given condition of combinations of conductors, the current in each and ambient temperature, the maximum temperature being limited by the ability of the insulation to withstand it. An additional type of building wire with a synthetic insulation covering is also recognized on this same basis and for certain of these conductors, both rubber covered and synthetic, it is permitted to reduce the thickness of the insulation primarily for the purpose of rewiring in old conduits. This whole new specification for building wires in the 1940 Code is a radical departure from past practice in that the current capacity is based more nearly on the actual ability of the wires to carry current and, therefore, appears at first sight to be rather complicated.

The new factors introduced and the additional complications have caused much discussion among contractors, wiremen and electrical inspectors and in some few cases, electrical inspectors have decided not to abide by the 1940 Code in this respect but to revert back to the current carrying values permitted in the 1937 Code for rubber covered wires because of the assumption that the simplicity of the 1937 specifications justifies their continued use. We feel that, in general, this practice is a mistake and that the specifications of the 1940 Code with respect to building wires offers many advantages which should not thus be abrogated and that with a little thought and study it will be found rather easy to apply the new current carrying values to advantage.

Apparently for the first time the current carrying ability of the various types of wires which are available has been set up on more nearly a scientific basis and while there are a few factors in the situation which will need attention later, taken as a whole the new specifications are much superior to those formerly used.

One of the most severe present limitations is in the current carrying capacity permitted for the larger conductors but every electrical engineer knows that, in general, it is more economical to use several conductors in parallel than a single large conductor where the higher values of alternating current are concerned. Such paralleling of conductors, however, is only permitted under the 1940 Code with the express permission of the authority enforcing the Code but it is expected that an Interim Revision of the Code will be made which will permit the more general application of parallel conductors for high capacities.

4. Increased Conduit Fills

For rewiring old raceways, the 1940 Code permits an increase in the percentage area of the conduit which can be filled with conductors and this provision coupled with the use of the new wires with thinner insulation, offers an immediate solution to many problems in the rewiring of old buildings where conduit, embedded in the building construction, has been used. The EEI, through its Wiring Sales Committee, has made available a booklet, publication No. I-3 dated August 1941, and titled "Rewiring for Commercial and Industrial Buildings" which, in effect, will serve as a manual for the solution of rewiring

problems using the new wires and methods now recognized in the Code. The price is 10c. each and it is recommended for your close attention for it will be a material aid in the solution of many difficult rewiring situations.

5. Requirement of Type S Fuses

Of all the new provisions of the 1940 National Electrical Code, perhaps the one of greatest concern to operating utilities is that requiring the use of plug fuses and fuse holders of a type designated as Type S after Nov. 1, 1941 (Sections 2452 and 2453, 1940 NEC). Briefly, the Type S fuse is described as follows: Fuses in the 16 to 30 ampere classification shall not be usable with fuse holders or adapters of the 0 to 15 ampere classification; Type S fuse holders and adapters shall not be capable of receiving fuses other than Type S; fuses, fuse holders and adapters shall be so designed as to be subject to tampering or bridging only with difficulty; when installed, no live parts shall be exposed; adapters once inserted in a fuse holder shall not be removable; Type S fuses, fuse holders and adapters of various manufacturers should be interchangeable with each other and suitable for use in the Edison Base fuse holder; and Type S fuses shall be of the plug type.

At the time this requirement was passed by the Electrical Committee, the Light and Power Group of that committee voted in the affirmative on the condition that a Special Committee of the Electrical Committee be appointed to develop a standardized Type S fuse which would meet the general approval of the entire industry. This Committee was appointed and after a year of study, reported back to the Electrical Committee at a special meeting held in Chicago, June 10 and 11 of this year, as will be discussed later.

6. Other Proposals not Included in 1940 Code

The Light and Power Group of the Electrical Committee was particularly anxious to have approved in the 1940 Code the general use of bare neutral wiring and the general use of the so-called covered neutral type of non-metallic sheathed cable, generally known as Type CNX. These proposals were turned down because they failed to receive the necessary two-thirds majority vote. However, bare neutral received an affirmative vote of 55 per cent of those present and voting and CNX received an affirmative vote of 63 per cent so these proposals failed to pass by a very slight margin. You are all probably familiar with these proposed wiring methods so time will not be taken here to go into them.

Special Electrical Committee Meeting, June, 1941

This special meeting of the Electrical Committee of the NFPA was called by Chairman Alvah Small to consider a number of items of importance that had been brought up since a previous meeting of the Electrical Committee in December, 1939, at which the 1940 National Electrical Code was compiled. At this special meeting a number of proposed revisions in the conduct and procedure of the Electrical Committee were considered and made. One of the most important of these revisions which was accepted was the continuance of the practice of making major revisions in the NEC every three years with provisions retained, however, for Interim Amendments. Of the other items considered, the most important were as follows:

1. Airplane Hangars

A technical subcommitee was appointed to formulate rules to be included in the Code relative to the wiring of airplane hangars. This Committee is to report to the next Code revision meeting.

2. Standardization of Wire Sizes

The U. S. Department of Commerce recommended to the Electrical Committee that the number of sizes of conductors now recognized in the Code be revised to include a minimum number of sizes and that the maximum size conductor for building wiring be the 500,000 cm size. The Electrical Committee voted to recommend to the NFPA that this proposed simplified practice be approved but so far as is known, this action has not yet taken place.

3. Proposed Interim Amendment No. 38

The National Electrical Contractors Association together with certain of the wire manufacturers had previously proposed an Interim Amendment to the Code, known as No. 38, which would have brought about a sweeping revision of the 1940 Code requirements with respect to building wires. This included, among other things, the proposed substitution of a brand new type of rubber insulated wire for present Code grade Type R and perhaps others. It included proposals on a purported simplification of the current carrying capacity tables and other provisions and after some discussion of this proposal on the floor, the manufacturers presented a motion that the entire subject be referred to the proper Article Committees of the Code for further study so that a full report can be made at the next Code revision meeting. This was agreed to and the manufacturers were urged to have a fact-finding report available at the earliest opportunity.

4. Wires in Multiple

Proposed Interim Revision No. 38 also contained a section on the use of wires in multiple and it was agreed that this portion be referred to the appropriate Article Committee at once as a separate Interim Amendment proposal to be acted upon as quickly as possible. It may be, therefore, in the near future that an Interim Amendment of the Code will be passed permitting the general use of wires in multiple which, of course, is very desirable.

TYPE S FUSES

The special technical committee which was appointed at the previous Code revision meeting in December, 1939, to study the possibilities of a standardization for the Type S fuse reported to the Committee agreement on a type of fuse which would not only meet the general requirements as set down in the 1940 Code for the Type S fuse but would also be interchangeable with the present Edison base type fuse. This fuse would not only be a very good mechanical job but, because of its interchangeability with the Edison base type plug fuse, it would be one which would meet all the requirements of the utility industry. With it, it would have been possible to immediately substitute the new type for all of the present types of plug fuses including the present so-called tamper-resisting types. The proposed fuse would be so arranged that by the use of adapters the 16 to 30 ampere fuses could not be placed readily in the 0 to 15 ampere fuse holders equipped with adapters, would be subject to tampering only with difficulty when installed with adapters and would meet the other requirements including the recommended interchangeability.

This report of the technical subcommittee was given consideration on the floor of the meeting and though the Light and Power Group voted for its adoption, the Committee turned it down

and instead, adopted the so-called thread dimensions of the patented Fustat type of device as the basis of proposed standardization for the Type S fuse. You are all probably familiar with the Fustat and the fact that its use will require the continuation of at least two general types of plug fuses.

It was also voted at the meeting that the use of the Type S fuse would not be retroactive; that is, its use would not be required in existing installations, being confined merely to new installations. Therefore, it will be necessary that the manufacture of Edison base fuses be continued as well as the manufacture of the new Type S. The owner of the patent on the Fustat arrangement, the McGraw Electric Company, tentatively agreed to enter into an agreement with the National Fire Protection Association that any manufacturer of fuses in the United States or Canada could manufacture ordinary fuses to the Fustat thread dimensions without royalty provided certain requirements were met, and a Special Committee was appointed to draw up a suitable agreement. It is my understanding that this agreement does not include the time delay feature of the Fustat and that manufacturers wishing to make time relay fuses of the new type presumably must pay a royalty to the patent holder. In other words, the time delay plug fuse of the Type S will be under the control of the present owner of patents which are presumed to cover it.

The vote of the Committee adopting this particular specification for Type S fuses did not include representatives of the NEMA, the Bureau of Standards or the Light and Power Group, these members of the Committee being recorded as not voting on the question.

Since this special meeting of the Electrical Committee, the subcommittee appointed to draw up an agreement with the McGraw Electric Company has reported and this agreement will be discussed later.

The importance of this requirement for Type S fuses in the National Electrical Code and the subsequent agreement on a purported industry standard for the Type S fuse to the utility industry cannot be over-estimated and unless very substantial agreement on a single standard for plug type fuses is reached, the confusion which will naturally result will not only be a source of major trouble to the utilities but will be reflected in increased service costs.

The Edison base plug type fuse has been in use for many years, almost since the inception of the electrical industry, and while it is true that it is rather easy to tamper with it, nevertheless it has been an eminently satisfactory protective device through the years. Because, however, of the seeming prevalence of tampering with these devices by those who do not fully appreciate the protective purposes for which they are used, it has been felt for some time by some in the industry that the substitution of a fuse more difficult to tamper with would be beneficial. The Light and Power Group representatives on the Electrical Committee have recognized this fact and for that reason, voted in favor of the requirement in the 1940 Code for the Type S fuse. However, this group also recognizes the fact that unless a single standard device is adopted which would have the support of all groups in the industry, the desired purpose would fall short of accomplishment, very likely resulting in a worse situation than now exists with the Edison base type device.

For instance, you are all familiar with the unending confusion before the Edison base was adopted as a standard for incandescent lights and it is believed that the use of two or more types of fuses will result in a condition similar to this, for in spite of the fact that a standard has presumably been adopted for the Type S fuse, this will not necessarily be the only standard Type S fuse, as will be shown later.

However, it should be well understood by all that the light and power industry is more appreciative than any other group of the desirability of proper protection for electric circuits and equipment and that the minimizing of tampering with such protection is a very desirable thing.

We understand that the development of the so-called non-tamperable type of fuse in its present forms had its conception in a requirement by the Underwriters' Laboratories that long time delay fuses made available especially for the protection of individual fractional horsepower motor driven appliances be made so as to be non-interchangeable in the various current capacities. Such devices were originally made in the Edison base but we have been informed that the requirement of the Underwriters for non-interchangeability forced the development which finally resulted in the Fustat type of device. This device was subsequently offered as a so-called non-tamperable fuse for general use and it is our understanding that about 140 cities in the country have required the use of these devices in new and old installations and do not permit the use of Edison base fuses.

The first mention of a non-tamperable fuse in the National Electrical Code was in the 1933 edition in which the use of this special type was made permissive. In the 1935 Code the use of this type was made mandatory after July 1, 1937. This requirement, however, was never put into effect because of an Interim Amendment to the Code and in the 1937 edition of the Code, the use of this type of fuse was again made permissive. In the 1940 edition of the Code, as has been stated, the mandatory use of a Type S fuse after Nov. 1, 1941, was included but in none of these editions of the Code, except that of 1935, was it required that the so-called non-tamperable type of fuse be interchangeable between devices of the various manufacturers and in none was it required to be interchangeable with the Edison base type. It is thought that the lack of this provision has been the major cause of the vacillation of the Code requirements in this respect.

During this period of uncertainty in the Code a second type of non-tamperable device was made available, this known as the Tamres, and there is still no provision in the 1940 Code that definitely specifies the dimensions of a Type S fuse and consequently there are no provisions which will prevent any number of these devices being made available and used.

Prior to August, 1938, the Underwriters' Laboratories listed as approved tamper-resisting fuses, both the Fustat device and the Tamres device. During August, 1938, however, upon re-examining these devices on the basis of a set of requirements for non-tamperable plug fuses and adapters drawn up by the Underwriters' Laboratories, the listing of these devices as non-tamperable fuses was withdrawn but listing as special types of plug fuses was continued. It evidently is now proposed to approve and list the Fustat type of device as a Type S fuse meeting the requirements of the National Electrical Code, but it is not known as yet whether the Tamres type of device will also be approved on this same basis by the Underwriters' Laboratories. It is rather inconceivable that one could be so approved without the other on the basis of being subject to

tampering only with difficulty, this especially in view of the fact that approval on this basis has already been withdrawn on one occasion for these same devices.

An examination of the proposed Type S fuse reveals the fact that it is quite easily tampered with, that 30 ampere fuses can, without much difficulty, be inserted in the 15 ampere adapters and are designed to fit the 20 and 25 ampere adapters and that the threads of the adapters, which are made of molded Bakelite, are very easily destroyed. The fact that the threads of the adapters are not very strong means that they are very likely to be damaged in service and when damaged so that they will not properly hold the plug fuses, a very great inducement for tampering will be brought about. It would seem to be a very important provision that whatever device is adopted should be at least as good mechanically as the Edison base type fuse, for it will be readily appreciated that broken adapters in service would be a source of unending trouble to utility companies who endeavor to maintain fuses on customers' premises.

Seemingly, by action of the Electrical Committee at its special meeting in June, a standard has been adopted for the Type S fuse; anyone can make it who meets the requirements of the Agreement between the owner of the patent and the NFPA, and also that the device meets all the requirements of non-tamperability and otherwise as laid down in the 1940 National Electrical Code. This, however, does not appear to be the case when the proposed Agreement between McGraw Electric Company, the present owner of the patents on the Fustat type of device, and the National Fire Protection Association, International, is reviewed.

For instance, the Agreement only extends to patent No. 2209048 and it is our understanding, does not cover the time delay feature in the plug type fuses. This would mean that many of the users of time delay fuses could obtain them only from otherwise licensed manufacturers.

The Agreement also contains a provision that the general "license shall extend only to devices that may be approved according to the definition of approved in the 1940 edition of the NEC and as explained or discussed in the ninth paragraph of the Introduction of said edition." It is also agreed that listing by the Underwriters' Laboratories will constitute such approval. However, this also means that approval only by the authority enforcing the Code is required.

The NFPA also agrees that it has duly approved the action of its Electrical Committee in adopting the thread dimensions involved as its standard for Type S fuses and fuse holders. On this basis it is maintained by some that since a standard for the Type S fuse has purportedly been adopted, actually the 1940 edition of the Code has been changed to include this and, therefore, the proposal must be approved by the American Standards Association before it can possibly become an American standard. Some maintain this is not so but if a national standard has been adopted, it assuredly should have the approval of the American Standards Association.

The proposed agreement further provides as follows:

"It is understood and agreed, however, that the Association shall reserve the right to recommend from time to time any other type or types of fuses or fuse holders or dimensions therefor, if in the judgment of the Association, constructions are developed which more satisfactorily meet the purposes of the Type S. fuse as specified in the said Code for 1940."

It is my opinion that this provision leaves open the way for different types of devices from time to time in the future, even within the life of the patent covered by the Agreement which is, as time goes, a comparatively short period.

One of the arguments used by the proponents of the present proposed standard Type S fuse has been that usage has made it a logical standard and it is stated that about three million devices of this type have already been sold. If it is assumed that half of this number are at present in service, it will be readily appreciated that this is a very small part of the estimated three hundred million Edison base fuses at present in service and that such minor usage certainly would not constitute grounds for making this type of device a national standard unless it otherwise met all requirements and substantial approval of the entire electrical industry.

Another factor very seriously entering this situation is the difficulty of manufacturers other than the present one arranging for the production of fuses of the new Type S. Special machinery is required and a goodly amount of toolmaker hours will be necessary. There is also the probability that machinery for holding the close tolerances required, especially in porcelain parts, may be patented and not freely available to the present fuse manufacture. All of this is particularly undesirable in view of the present Defense effort and many months must necessarily elapse before any manufacturers other than the present one could begin to produce the devices and in the meantime, they would be excluded from the fuse market for new installations.

Then, too, a determination of the question of whether or not a manufacturer meets the requirements of the proposed Agreement is within the province of the present owner of the patent only. In other words, for the present and perhaps for the future, the entire plug fuse situation will be under the control of a comparatively small group of individuals.

So far, not very many utility companies in the country have displayed much interest in this whole proposition but I believe that this is because of the fact that they do not realize the importance of this new restriction in the Code which required the Type S fuse. Actually, in my estimation this is the most radical change that has ever been made in the Code in its history and it is one that can readily bring again to the utilities the difficulties that were experienced when we had two bases for incandescent lamps; that is, the Edison base and the Thomson-Houston base.

Also, at present many utility companies are spending thousands of dollars yearly in providing satisfactory service to their customers by maintaining fuses on the customers' premises. Therefore, any change of this sort will vitally affect the service situation as well as its cost.

Policy with respect to fuse maintenance on customers' premises varies with different utilities. Some companies make a charge for the service while others furnish it on a free basis. However, as you all well know, the customer generally looks to the local utility for maintenance of service on his premises irrespective of this practice and the utility company's service in this respect is entirely different from that of other branches of the electric industry, such as the maintenance of radios, appliances and the like. When electric service fails, it is of serious moment to the customer and this seriousness is growing because of the rapid increases in the use of oil burners, water pumps, refrigerators and other indispensable appliances, particularly in the rural areas and where the use of such equipment is entirely dependent upon a constant supply of electricity. Where service fails, the utility is often blamed and not the manufacturer of the protective

devices, the contractor or even the electrical inspector who may have required the use of special types. Therefore, it seems to me that we in the utility business by far have the most at stake in providing a most practical solution to the problem of protective equipment on the customers' premises.

There is no question in my mind that a practical solution can be found to decrease the possibilities of tampering with branch circuit fuse protection and that when it is found, it should receive our heartiest endorsement. However, the advantages of any device for this purpose must be greater than any disadvantages attendant to its use and it must resist tampering to a degree consistent with the hazards involved and be vastly superior to the present practical device in general use—the Edison base type plug fuse. It must be sound mechanically at least to the extent of the Edison base fuse.

In the formulation of standards for the electrical industry it has always been the practice to bring together representatives from all branches of the industry. This was done in the Special Committee which the Electrical Committee appointed to recommend a standard for the Type S fuse and this Special Committee did recommend a practical device, meeting to a sufficient degree all of the assumed requirements and one which would be a practical answer to the problem from the standpoint of all concerned. However, this proposal of the special technical committee did not meet with the approval of those in the Electrical Committee who voted for the adoption of the Fustat type device and the situation was such that the parties of major interest; that is, the NEMA, the Bureau of Standards and the Light and Power Group representatives, felt that it was best not to vote at all on the proposition as finally proposed.

We in the utility business are also concerned with another problem attendant to this situation. That is, while the Electrical Committee voted that the use of the Type S fuse would not be retroactive, there is no doubt that some electrical inspection authorities enforcing the National Electrical Code, will insist that Type S fuses be installed in present installations under various conditions encountered. For instance, if a new circuit is added in a home, Type S fuses may be required for it, whereas Edison base type fuses would remain for the balance of the circuits. This would mean that the fuses in a given installation would not be interchangeable and you can appreciate the position of a "lady of the house," when desiring to purchase fuses, explaining to the merchant that she wants a Type S time delay fuse or a Type S standard fuse or an Edison base time lag fuse or an Edison base standard fuse in the 15, 20, 25 or 30 ampere capacity, as the case may be. There is no doubt but that ultimately she will have to consult with the utility company's service man before she can get things straightened out. Then she may not be able to get the required type at all, especially on a week-end or holiday.

Actions already taken by some local enforcement authorities indicate that this requirement for Type S fuses may not be enforced in many localities; first, because of the legal aspects of the situation and, second, because the proposed device does not constitute a true industry standard. There are many other provisions in the NEC which are also subject to this type of lack of cooperation, such as mentioned previously—the current carrying capacity of building wires. This growing tendency to ignore certain provisions of the Code has the effect of breaking down the effectiveness and usefulness of the Code as an industry standard and if this trend is permitted to go much further, a good deal of the respect for the Code which has existed in the industry will undoubtedly be nullified. And I think it is entirely in order to say that the utility companies as a group do not desire to see this condition brought about but would much prefer to see the practicability of the National Electrical Code and industry respect for it fully maintained.

Today it is not necessary to provide proper circuit protection solely by means of fuses. For a number of years now, automatic circuit breakers have been available from many manufacturers which provide equivalent protection to that supplied by means of fuses. These devices are quite economical to install; in fact, their cost of installation is even lower than that of fused equipment in many instances. They provide all the desired features of resisting tampering with difficulty, they expose no live parts to accidental contact and provide a ready means for the customer to restore his own service when the protective device operates for any reason. It is merely necessary to flip a lever similar to operating a wall switch. There is nothing to replace and no new parts to buy. It is, therefore, immediately evident that through the use of circuit breakers the entire problem in connection with tamper-resisting fuses is obviated and yet all of the desired features in low capacity branch circuit protection are readily and economically accomplished. We suggest that serious attention be given to the promotion of the more general or exclusive use of these devices.

The "Last Full Measure"

(*Continued from Page* 440)

I would do good deeds, and forget them straightway;
I would weave my woes into ropes and climb
Up to the heights of the helper's gateway;
And Life should serve me, and Time,
And I would sail out, and out, and find
The treasures that lie in that deep sea, Mind.
I would dream, and think, and act;
I would work, and love, and pray,
Till each dream and vision grew into a fact
If I were a man, a young man, and knew what I know today.

If I were a man, a young man, and knew what I know today,
I would guard my passions as kings guard treasures,
And keep them high and clean.
(For the will of a man, with his passions measures;
It is strong as they are keen.)
I would think of each woman as someone's mother;
I would think of each man as my own blood brother,
And speed him along on his way.
And the glory of life in this wonderful hour
Should fill me and thrill me with conscious power,
If I were a man, a young man, and knew what I know today.

Oh! "Columbia, the gem of the Ocean" may you forever be, the land of the free and the home of the brave.

Lighting and Air-Conditioning Design Factors

A report of a joint committee on Lighting in Air Conditioning of the Illuminating Engineering Society and the American Society of Heating and Ventilating Engineers, Howard M. Sharp, Chairman.

Courtesy *Illuminating Engineering* and *Heating, Piping and Air Conditioning*

DURING the fall of 1939 the joint committee on "Lighting in Air Conditioning," of the Illuminating Engineering Society and the American Society of Heating & Ventilating Engineers, initiated a design survey of representative air-conditioning installations. The purpose of this investigation was to bring to the attention of air-conditioning engineers and illuminating engineers the relative magnitude of the various heat gains, general practice in the circulation of air and location of air grills as related to position of lighting, and the range of design temperatures.

Through the cooperation of the Air Conditioning Manufacturers Association, 82 installations were made available for study, representing a wide geographical selection. The essential data are summarized in Table I, and from these the interested investigator may obtain what would be of value in any particular study.

The committee realizes that the interest in the material presented in Table I will depend upon the major interest of those referring to it. However, the increased interest in the cooling load component of a lighting system, particularly on the part of illuminating engineers working in conjunction with air-conditioning designers and architects, would seem to warrant further elaboration and interpretation of items 8 to 17, inclusive, in that table.

The sensory prominence of lighting has attracted to itself certain unfavorable attention as a source of heat gain and as a factor in discomfort due to sen-

*Effects of Artificial Lighting on Air Conditioning, by Walter Sturrock, Journal Section, ASHVE.
Cooler Footcandles for Air Conditioning, by W. G. Darley, ASHVE Journal Section, August, 1940.
Mean Radiant Temperatures of Lighting Systems with Comfort Correlations, by Howard M. Sharp, ILLUMINATING ENGINEERING, November, 1940, Vol. 35, No. 9.

TABLE I—LIGHTING AND AIR-CONDITIONING DESIGN FACTORS

1. Classification	Office			Restaurants		Apparel Stores				Department Stores		Drug Stores			Beauty Shops		Small Stores		Hotels	Apt. Bldg.
2. Location (section of U.S.A.)[a]	S.W.	S.	N.E.& C.	S.W.	N.E.& C.	S.W.	N.E.& C.	Cal.	Wash.	S.W.	N.E.& C.	S.W.	N.E.& C.	Cal.	S.	N.E.& C.	S.	N.E.& C.	S.	N.E & C.
3. No. of installations reported	3	9	19	1	8	5	10	2	1	2	9	1	1	1	1	1	1	5	1	1
4. Total floor area represented (thousands sq ft)	96.52	457.2	153.0	0.600	22.72	40.35	113.07	46.0	17.50	37.70	353.1	4.45	3.09	6.66	0.425	1.09	3.16	12.02	22.2	4.05
TOTAL COOLING LOAD																				
5. Computed, in tons (average per installation)	124.2	182.1	58.8	7.25	24.59	19.9	38.1	45.2	12.34	58.1	132.0	26.3	5.5	19.3	4.51	5.5	15.2	9.26	143	26.0
6. Computed, tons per 1000 sq ft floor area	4.12	3.58	38.2	12.00	10.2	2.38	3.35	2.17	7.00	3.28	3.32	5.9	1.78	2.9	10.6	1.09	4.80	3.99	6.44	6.32
7. Tons of refrigeration capacity provided	128.6	187.7	65.73	7.00	26.3	21.34	39.9	51.0	12.50	62.7	136	28.0	—	21.3	5.0	—	17.0	10.00	120	26.0
8. Ratio refrigeration installed to computed, in percent	102.5	102.2	112.0	100	105	107.0	104.0	112.0	100	107.0	103	107.0	—	105	117	—	111.0	108	84.0	100
LIGHTING																				
9. Watts in use per sq ft	2.72	2.11	1.876	1.0	2.03	1.75	3.33	3.0	8.1	2.13	3.01	1.8	0.7	1.8	1.06	2.7	5.73	2.28	2.25	3.0
10. Watts in use per cubic foot of conditioned space	0.214	0.20	0.128	0.063	0.162	0.162	0.400	0.297	3.15	0.1613	0.305	0.121	0.05	0.106	0.08	0.22	0.455	0.172	0.225	0.09
11. Ratio of watts in use to watts installed	100	76.4	58.95	100	81.3	85.9	71.7	100	—	100	95.7	80	100	80	100	100	100	100	50	55.9
COOLING LOAD COMPONENTS IN PER CENT OF TOTAL COMPUTED COOLING LOAD																				
12. Lighting	21.5	20.2	14.3	2.3	9.9	21.3	28.0	23.3	47.0	19.6	25.1	8.8	10.9	17.6	2.8	13.6	33.5	17.1	20.0	13.4
13. Solar radiation through windows	9.6	14.9	15.8	4.2	2.0	3.0	5.5	10.9	2.2	8.7	5.9	—	—	—	4.85	—	—	1.6	—	17.30
14. Conducted heat	27.8	19.3	25.8	10.0	13.6	34.5	24.1	29.5	17.4	17.7	15.3	13.0	36.4	18.9	30.6	18.2	14.0	32.5	32.9	50.0
15. Fresh Air	24.8	30.8	22.4	47.6	29.5	23.1	18.7	24.9	12.5	32.8	27.2	35.4	18.2	17.9	14.4	13.6	27.6	25.5	35.7	5.13
16. Occupants	9.8	13.3	12.2	25.0	26.0	14.7	19.7	17.2	18.2	13.8	22.5	33.1	27.3	36.2	15.5	13.6	11.0	15.7	11.5	5.1
17. Miscellaneous Heat Gains	3.0	9.2	9.0	10.0	30.3	3.1	4.5	—	2.6	6.8	5.0	9.9	18.2	9.4	30.8	36.4	6.8	8.3	—	7.7
AIR DISTRIBUTION																				
18. Fresh outside air in percent of total circulated	14.9	32.72	18.98	51.0	52.3	27.5	15.86	25.4	22.0	18.9	17.8	44.0	100	26.3	14.4	100	11.80	27.1	21.4	100
19. Total air circulated, in cfm per 1000 sq ft floor area	1,941	1,656	1,650	3,660	2,290	1,150	1,440	1,280	3,900	1,210	1,210	1,530	136	2,850	3,430	2,750	2,160	1,800	2,730	148
20. Total air circulated, in cfm per ton of total cooling load	476	424.4	452.3	304	251	477.2	433.2	556	552	367.5	410	259	76.3	984	323	54.5	403	416	432	23
21. Location of Air Grilles																				
Ceiling	.....	.....	6	.....	3	.....	2	3	.....	.....	1	.....	.....	1	1	.....	.....	.....	.....	.....
Sidewalls	3	9	8	1	3	5	7	3	1	2	8	1	.....	.....	.....	.....	1	5	1	.....
Distance above floor in feet	10	9	9	12	.....	10	11	—	9.5	13	12	12.5	.....	.....	12	.....	12	8.5	12	.....
22. Direction of Air Flow from grilles																				
Horizontal	2	9	12	1	3	5	5	3	1	2	7	.....	.....	.....	.....	.....	.....	2	1	.....
Downward	.....	.....	.....	.....	3	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Upward	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	2	.....	.....
23. Design Temperatures																				
Indoor Dry-Bulb	81	80	80	81.0	80	80	80	79	72	80	80	81.0	80.0	80.0	80	80	78	80	80	79
Indoor Wet-Bulb	66	67	67	65.9	67	64	67	66	60	67	67	65.9	66.0	66.5	66	66.0	66	67	67	66
Outdoor Dry-Bulb	101	81	95	96.0	95	98	95	93	83	100	95	96.0	95	95.0	90	95	95	95	100	95
Outdoor Wet-Bulb	77	77	77	76.0	75	76	76	71	61	78	78	76.6	75	70.0	65	75	79	76	78	77

[a] Abbreviations refer to sections of country as follows: N.E. & C.—Pennsylvania, Michigan, Illinois, West Virginia and New York; S.—Louisiana, Georgia, Tennessee and Kentucky; S.W.—Oklahoma and Texas.

sations of warmth that is not supported by available data.* When confronted with situations of this nature, the tendency has been to reduce the lighting component to the lowest possible value, thus disregarding the importance of adequate illumination in the creation of an environment that should return the maximum in health, comfort, efficiency and pleasure to the occupants thereof. Reference to Table I shows that the cooling-load tonnage assigned to lighting varies from 2.3 per cent of the total in the case of a restaurant in the Southwest to 47 per cent in the case of an apparel store in the Northwest. As another indication of magnitude, if all of the cooling load components in Table I are averaged arithmetically, the results are as given in Table II.

TABLE II

	% of Total Cooling Load
Fresh Air	24
Conducted Heat	24
Lighting	18
Occupants	18
Miscellaneous Heat Gains	11
Solar Radiation through Windows	7

It is evident from a study of the ratio of lighting watts installed to watts in use, item 11, that the demands of modern business are such that much of the available lighting is in use during periods of air-cooling. In 17 of the 82 installations studied, all of the watts installed were in use during cooling periods. With one not reported, the remaining 64 averaged 72 per cent of total watts installed, in use during cooling periods, thus providing a safety factor of a low order when viewed against the background of lighting growth and practice. This is further supported by the evidence disclosed in item 9, showing the average lighting watts per square foot to be 2.36. Ignoring variations in types of lighting systems, this indicates that generally speaking the lighting levels in the areas studied would not be expected to be any more than the minimums required, and hence enlargement of this element of the cooling load is inevitable.

However, a study of item 8 shows that very little spare capacity is being provided to allow for this expansion. Therefore, it seems pertinent to point out to engineers and architects the desirability of carefully studying contemplated installations with a view to providing more spare capacity initially, or making provision for future expansion

TABLE III—ANALYSIS OF LIGHTING AND AIR-CONDITIONING SYSTEMS FOR A LARGE DRAFTING ROOM

A—ANALYSIS OF LIGHTING SYSTEMS

		System 1	System 2	System 3
1	Type of lighting	Converted Indirect	New Indirect	Semi-indirect Fluorescent
2	Number of luminaires	102	102	102
3	Wattage per unit	500 SB	500 SB	300 (with ballasts)
4	Lamps per unit	1	1	6 (48" white fluorescent)
5	Rated lamp life hours	1000	1000	2500
6	Lamp cost, each	$1.28 (List, less 25%)	$1.28	$1.20
7	Lamp renewal cost for all fixtures	$130	$130	$734
8	Luminaire cost per outlet, net	——[a]	$15	$66
9	Total luminaire cost	——	$1,530	$6,732
10	Wiring cost	Present	wiring adequate	
11	Total investment	——	$1,530	$6,732
12	Yearly taxes, insurance and depreciation (25 percent of Item 11)	——	$383	$1,683
13	Burning hours per year	2000	2000	2000
14	Annual lamp renewal cost, net	$260	$260	$588
15	Total lamp renewal cost and write-off (12+14)	$260	$643	$2,271
16	Total wattage of all lamps and auxiliaries	51 Kw	51 Kw	31 Kw
17	Kwh/year (2000 hours use)	102,000	102,000	62,000
18	Annual energy cost. Always use the actual rate that would apply to incremental load; in this case based on one and one-half cents per kwh	$1,530	$1,530	$930
19	Total yearly charges (15+18)	$1,790	$2,173	$3,201
20	Average foot-candles in service	30	36	50
21	Cost per foot-candle year	$60	$60	$64

[a] Existing fixtures already written off; substitution of silver-bowl bulbs sufficient to make them reasonably modern.

B—ANALYSIS OF AIR-CONDITIONING CAPACITY ASSIGNABLE TO LIGHTING

22	Lighting load requiring additional cooling capacity, Kw	20	20	None
23	Btu per hour = Kw x 3415	68,300	68,300	
24	Tonnage of air-conditioning system = Btu per hr / 12,000	5.7	5.7	
25	Installed cost of air-conditioning system. In this case based on $400 per ton; if exact figure not known, $300 a ton may be assumed as fair average for commercial installations; no averages applicable to industrial areas because of wide variations in design and installation requirements.	$2,280	$2,280	
26	Hours use of air-conditioning	1,000	1,000	
27	Annual power cost. Average air-conditioning system input approximately one kw per ton; power cost = air conditioning tons × hours use of compressor × energy rate.	$57	$57	
28	Hours use of water	2,500	2,500	
29	Water cost. Dependent upon water temperature, average 2.5 gpm per ton; water cost = 150 × air-conditioning tons × hours use of water × water rate. (13c per 1000 gal for this study).	$278	$278	
30	Refrigerant cost. One charge per year average, at $2.00 per ton.	$12	$12	
31	Labor and maintenance. Average $10 per ton per year.	$57	$57	
32	Taxes, insurance, interest and depreciation. (15 percent of Item 25).	$342	$342	
33	Total yearly charges. (Sum of Items 27, 29, 30, 31, and 32).	$746	$746	

C—COMBINED LIGHTING AND AIR-CONDITIONING COST SUMMARY

34	New money required			
	Lighting (Item 11)	.....	$1,530	$6,732
	Air-Conditioning (Item 25)	$2,280	$2,280	.....
		$2,280	$3,810	$6,732
35	Annual ownership cost			
	Lighting (Item 12)	.....	$383	$1,683
	Air-Conditioning (Item 32)	$342	$342	.....
		$342	$725	$1,683
36	Annual operating costs			
	(a) Lighting			
	Lamp cost (Item 14)	$ 260	$ 260	$ 588
	Current cost (Item 18)	1,530	1,530	930
		$1,790	$1,790	$1,518
	(b) Air-Conditioning			
	Power (Item 27)	$ 57	$ 57	.....
	Water (Item 29)	278	278	.....
	Refrigerant (Item 30)	12	12	.....
	Maintenance (Item 31)	57	57	.....
		$404	$404	
37	Total yearly charges			
	Lighting (Item 35)	.....	$ 383	$1,683
	(Item 36a)	$1,790	1,790	1,518
		$1,790	$2,173	$3,201
	Air Conditioning (Item 35)	$ 342	$ 342	.....
	(Item 36b)	404	404	.....
		$746	$746	.....
	Total	$2,536	$2,919	$3,201
	Total per foot-candle year	$ 84	$ 81	$ 64

with a minimum of incremental cost. What this factor of safety is to be will, of course, depend upon the type of area being conditioned and the relationship between lighting load and total cooling load. In restaurants, for example, the lighting load appears to be less than 10 per cent of the total cooling load. Offices show a ratio of around 20 per cent, while mercantile establishments vary from 10 per cent to 50 per cent. Areas showing small percentages offer less of a problem than do those with heavier lighting loads. At the same time, areas devoted to seeing tasks and merchandising undergo the most rapid changes in lighting so that air-conditioning capacity should be thoughtfully planned in order to safeguard the ultimate best interests of consumer and industry alike.

It is uncontrovertible that in an air-conditioned interior a given lighting result should be accomplished in the most effective manner, taking into consideration the illumination requirements, resultant influence on cooling, and comparative costs. There is, first, the choice of light utilization devices involving materials, cost, method of application and efficiency. Next, the commercial development of gaseous discharge lamps, including the principle of fluorescence, presents another set of alternatives to the engineer. It is increasingly possible to obtain the higher standards of illumination known to be desirable in the attainment of better seeing, with relatively smaller increments of sensible and radiant heat, but the cost of the lighting system to accomplish this result does not bear a simple relationship to the actual or theoretical reduction in the energy and equipment costs necessary to remove the heat gain. The committee therefore presents for consideration a method whereby the cost relations between lighting and its concomitant cooling component can be analyzed. The lighting constants were taken from a standard comparison method promulgated by the Edison Electric Institute, published in December, 1939, in a report entitled "Fluorescent Lighting Practice" and now in general use by illuminating engineers. The air-conditioning constants are in part derived from the fundamentals of physics and from standard practices of the industry.** This method constitutes a formula that can be applied for the purpose of comparing the effect of any number of lighting plans upon cooling load components.

In order to develop a better understanding of its application, there is presented in Table III an actual study of a large drafting room now air-cooled and lighted with revamped totally indirect equipment averaging 3 watts per square foot. Original air-cooling capacity allowed for 5 watts per square foot, but the spare capacity having been diverted to other areas, the owners desired to know whether it would be more economical to install additional capacity to allow an incandescent lighting load of 5 watts per square foot, or hold the lighting load at present capacity by utilizing fluorescent lamps. No conclusions should be drawn from the numerical results shown because every case must be judged in the light of conditions that exist. For the sake of simplicity, only round numbers are used in the calculations.

The figures relating to lamp and fixture performance and prices are correct as of April, 1941. The basic method will, of course, be uninfluenced by changes in equipment or prices. Experience has shown, however, that several of the items should be carefully investigated in each instance.

Lamp cost and luminaire cost should be entered at the price which would be quoted through legitimate channels. Light sources, for example, may be bought on contract, or in standard package quantities over the counter, at established discount. There is no intention of advocating the publication of discounts or the purchase of equipment at other than established prices, but true values should be used.

In the example given, Item 10 on wiring cost was left blank because there is no evidence of sufficient uniformity of conditions or cost to risk the use of a figure which might cause embarrassment. It should not be left out of specific studies if additional wiring is involved. Many relighting jobs, on the other hand, may not require rewiring. However, the influence of poor power factor should not be ignored in wiring calculations.

Installation costs have not been provided for, nor has the influence of labor charges for lamp replacements been included. These may be sizeable items, particularly in an installation involving a multiplicity of light sources, and should be considered if figures are available.

Items 12 and 32 are ones over which some difference of opinion may arise. It is urged that when preparing an analysis for a specific job, the fixed charge percentage be agreed upon with the customer. Some may prefer to spend money and forget it. Others may wish to use a different rate of depreciation for wiring than for fixtures. Insurance and taxes will vary. However, the fixed percentages used in the example represent good accounting practice and may be used in the absence of specific data.

Power costs will, of course, vary with locality, the magnitude of use, and the class of service. In smaller installations, a variation in consumption between two methods of lighting may result in per kwhr charge differences, because of the effect of sliding scale or block rates, or as result of demand component in two-part rates.

The hours' use of water may not coincide with the hours' use of a cooling compressor. Under certain conditions, water alone may be used during certain periods to effect a reduction in air temperature, thus adding to the total hours during which water is consumed. In this particular study, water was used for 2500 hours a year, compared with 1000 hours for the compressor.

A growing practice is the use of cooling towers or evaporative condensers which reduce the amount of water required to around 4 per cent of that consumed by the "once-through" use of city water. However, this results in an increase in the total investment and use of auxiliary power, all of which would be resolved in arriving at the items of all-over water cost.

Item 25, "Installed Cost of Air-Conditioning Equipment," is subject to considerable variation. In many instances, *additions* to an existing system would involve less in the way of control devices and engineering expenses, thus reducing the amount per ton to perhaps as low as $250.00. It is often the case that the exact amount of additional capacity to handle the lighting load cannot always be purchased. In the study in question, a compressor of 5.7 tons would not be purchased; a 6-ton unit would be standard. On the other hand, when installing additional incremental capacity there may be other cooling requirements to consider which would allow the exact amount needed for lighting to be allocated to it for accounting purposes.

**ASHVE Guide, 1941 Edition, Chapters 6-8-20-21-22-23-25.

Metal Shortages and Their Effect on Line Hardware

Report of the Line Hardware Subcommittee, EEI

By Earl H. Kendall
Commonwealth & Southern Corporation

Presented at a meeting of the Transmission & Distribution Committee, EEI, Cincinnati, Ohio—Oct. 20-22, 1941

THE September issue of *Metal Progress* reports in an article entitled "Conservation and Substitutions Required by Metal Shortages" that the feeling in official Washington is one of alarm concerning the supply of metal and that satisfactory supplies exist for only four metals. The present shortages now include metals that were not even on the critical list a few months ago. This article emphasizes that engineers throughout the country should, therefore, realize that conservation, substitution, and even elimination are the order of the day.

The Line Hardware Subcommittee of the Edison Electric Institute desires to report as accurately as possible concerning the present and future prospects for the metals required for transmission and distribution construction and bring to your attention some of the substitutes, reductions and eliminations that have been suggested. The presentation of this material is through the assistance of the hardware manufacturers, the strand manufacturers, and members of this committee. In making this report, it is obviously necessary to omit the trade names of some of the products mentioned. While the two most important items from the standpoint of quantity, at least for the production of line materials, are steel and zinc, many other materials such as lead, tin, and copper, although not used in large quantities, are essential for transmission and distribution construction and are difficult to secure.

During nineteen forty, this country produced sixty-seven million tons of steel. This year, ninety-one to ninety-two million tons are scheduled, which will be approximately the total steel mill capacity to January, nineteen forty-two. To adequately take care of both defense and civilian requirements, it has been estimated that the capacity as of January, nineteen forty-two, will have to be increased some thirty million tons, or up to one hundred twenty million tons. An indication of the tremendous task to make this increase is that to make an increase of ten million tons, it will take two years' work of one-half million men and the withdrawal of over four million tons of steel for the construction. Other factors in the production of steel, such as the procurement of scrap iron, the proper alloying elements, and power for the electric furnaces, add to this task. The general picture for the other important item for line hardware — zinc — is, according to the best information, about as follows:

During nineteen forty, seven hundred twenty-four thousand tons of zinc were refined and smelted in North America from ore and secondary metal, and the operating rate in December was about seven hundred eighty thousand tons per year. The estimated nineteen forty-one demand is about nine hundred thirty-five thousand tons, which is some fifty thousand tons more than the maximum refinery capacity. The official opinion is that there will be enough zinc for defense requirements in nineteen forty-one and nineteen forty-two if forty thousand to fifty thousand tons per month of concentrates are imported but the civilian supplies must be cut at least ten per cent in nineteen forty-one, and probably three times as much in nineteen forty-two. There is a present shortage, as measured by demand; however, there is no actual shortage for defense and basic civilian use, but the requirements for defense will increase. As there seems to be no way to increase the immediate supply, the amount of zinc for distribution and transmission construction may be less and less, and every opportunity should be taken to conserve the supply for the essential items. Recently published ratios of the present supply, after defense requirements are met, to the apparent civilian demands for some of the common metals are about as follows:

> Aluminum, one to fifteen; copper, two to five; zinc, two to three; tin, two to three; steel, nine to ten; and lead, one to one.

Although the line hardware manufacturers are required to produce some forty-five hundred different items for overhead construction, for the most part one grade of steel, a plain carbon steel made in accordance with ASTM A-7 specifications is used. This same grade of steel is also used for building construction, substations, transmission towers, bolts, and other miscellaneous purposes. About seventy thousand tons of steel per year are required for ordinary line construction of the miscellaneous items, exclusive of towers, substations, steel strand, and wire for reinforcing conductors. Practically all of the seventy thousand tons of miscellaneous items are hot dip galvanized with coatings around two ounces per square foot, requiring some seven thousand tons of zinc. This requirement, added to that required for steel strand, which is about five per cent of the weight of steel in the strand, and structural steel, which is about three and one-half per cent of the weight of the steel, makes an over-all requirement of a considerable tonnage. These requirements, combined with other civilian requirements, will be met after the direct defense allotments are made, and for this reason every effort should be made to conserve the supply by substitution, elimination, redesign, and the use of standard items.

An article in a recent issue of a Bell Laboratory publication cites how defense materials are being conserved in the Bell System by changes in specifications and

by the use of substitute materials. The article reports that as of July first, nineteen forty-one, the intended yearly rates of use of aluminum will be reduced by one million six hundred seventy thousand pounds; of nickel, by two hundred thirty-eight thousand pounds, and of zinc, by three million three hundred eighty thousand pounds.

A greater reduction in the steel and zinc requirements for power construction can be made by the use of wood than by any other change without loss of strength and life, with improved operating characteristics, and at a lower cost.

Wood pins can replace steel pins on distribution; wood braces can replace steel braces; wood guy guards can replace steel guy guards; wood H-frames can replace steel towers, and wood substations can replace steel substations. All of these designs have a rather wide use and many variations and designs of each item are available from the very simplest, with but little steel, to the more elaborate, with much steel. The use of some of the lighter designs, with but little steel, has proved their reliability and adequacy. Some of the wood braces have no other steel than clamp type washers, and some of the H-frame designs with double planks use wood spacers with timber rings instead of steel spacers, and secure additional strength at lower cost. The present deliveries of some twelve to twenty weeks, and the increased cost of structural steel substations, make wood substations for voltages up to 66 kv attractive to replace the steel structures, and many companies are taking advantage of this material. While suitable structural wood is not plentiful, it is available in ample quantities, either treated with creosote or Pentachlorphenol, to supply the present demand.

At present, the supply of zinc for transmission and distribution appears to be adequate. However, the outlook for the future is rather indefinite and there is a feeling that some substitutions may be necessary, either in the way of lighter coatings or entirely different coatings. For this reason, it seems desirable to discuss some of the substitute coatings and methods of preserving the present zinc coatings. Various methods for increasing the corrosion resistance of steel have been used to a greater or less extent, a few of which are as follows:

Cadmium plating, which is perhaps the most common substitute for zinc coatings, can be supplied only by spraying or plating. Such a coating is much more expensive than zinc as the metal is more costly and the corrosion resistance is not as high as zinc. This coating has been condemned largely because it usually does not have sufficient thickness for the proper protection of the base material. Cadmium is a by-product of zinc but sufficient quantities are not available to replace zinc.

Lead and lead alloy coatings have been used largely as protection against the corrosion effect of chemicals. However, recent research of such coatings as indicated by the ASTM A-5 Corrosion Report indicates a wider field of application is possible. Such coatings, like the copper coatings, in contrast to cadmium and zinc are cathodic and protect the base material only mechanically. Because of the good bond between the steel and the lead coating, much better results (as given in the A-5 report are being obtained than originally anticipated, and this coating offers possibilities as a substitute for zinc on hardware and steel. At the present time, some hardware is being coated with lead. Consideration is being given to lead alloy coatings for strand, and some thought is given to a lead alloy coating followed by a paint coating after stranding as a substitute in case zinc is not available for strand manufacturing. These coatings are of considerable interest at this time, both because of the good corrosion resistance and because the supply of lead is more plentiful than zinc.

Chromizing is a rather new process for increasing the corrosion resistance by forming a chrome iron alloy on the surface of the metal through action of chromium salts on the heated metal, but little data is available on the value and availability of this treatment.

Vitreous enamel has been used on some types of electrical equipment such as transformer cases, meter boxes, and other items. However, because of the brittleness of this type of coating it is not practical for line construction.

In addition to these substitute coatings, there is also the possibility of entirely eliminating coatings on some items by using materials of somewhat higher corrosion resistance, such as copper bearing steel and wrought iron. In fact, many uncoated crossarm braces of copper bearing steel were installed by one of the telegraph companies prior to the scarcity of zinc to lower the initial cost, and satisfactory results are reported. Wrought iron, which has a greater corrosion resistance than plain carbon steel on account of the silicon content, is the oldest corrosion resistant material of the ferrous metals and has a very good record. While this material does not have strength equal to steel, in many cases but slight modifications in design are necessary to provide the proper strength.

In addition to these metallic coatings which are applied by the manufacturers, a wide variety of paint and lacquer coatings furnished under various trade names are available. There are many paint manufacturers, each producing paints for every purpose, with special claims for each of them. Included are a number of special paints for painting rusted steel or to be used as a substitute for zinc coatings. The general results of an engineering study being made on the relative merits of some of the paints for the protection of tower and substation steel seem of sufficient interest to include in this report. This study includes information from actual field tests, exposed sample tests under field conditions, and accelerated weathering tests.

It is found that the better paint coatings, properly applied, will give the necessary protection to steel structures for five to ten years, depending upon atmospheric conditions, which is in some instances equivalent to the life of zinc coatings in the same locations. Based upon the results obtained, it is believed that such coatings are logical substitutes for zinc, either on new work or to replace rusted zinc coatings on present equipment. To secure the maximum life from any paint coating, it is necessary to properly prepare the surface and to select the proper type of paint for the particular application. Some of the most widely used methods for cleaning and preparing steel surfaces prior to the application of the paint coating include one or more of the following: sand blasting, flame cleaning, wire brushing, scraping and chipping, parkerizing, bonderizing, and other phosphate treatments. Sand blasting is one of the most effective ways of removing rust and mill scale, but this method requires elaborate equipment and introduces a high cost factor which cannot be justified on many applications. Flame cleaning is being used more extensively, particularly on structural sections. Wire brushing is undoubtedly the most common method, and while it does not produce as clean a surface as sand blasting, satisfactory results can be obtained. The removal of mill scale on new steel is essential and this is usually done either by sand blasting, acid pickling, or weathering. An interesting point in connection

with the weathering method is that a coat of linseed oil over the mill scale will accelerate the removal of the scale and leave a good surface for the paint coat. Parkerizing and bonderizing and other phosphate coatings which are used extensively in automobile production produce a roughness or tooth on the surface of the metal and thereby increase the adherence of the subsequent paint coatings. Although there are some paints for steel on the market that are recommended as one coat paints, most paints consist of primers and finishes, or systems. The primer coat for steel should contain a pigment which has rust inhibitive characteristics and makes steel passive to oxidation, thereby reducing the rate of corrosion. The final coat is applied to prevent moisture penetrating through the metal surface and to improve the appearance. The type of finish or top coat to be used depends to a large extent on the service to which the painted material is subjected.

Paints are classified according to pigments and vehicles. The general classes of pigments which have rust inhibitive characteristics include red lead, blue lead, basic lead chromate, zinc chromate, red iron oxide, and lead suboxide. The vehicles include the following: linseed oil, china wood oil, fish oil, bakelite (phenol formaldehyde), and alkyd type vehicles. In addition, Paralon or chlorinated rubber has lately been introduced in combination with certain pigments and vehicles. The paints containing an oil type vehicle are usually classified as slow drying, and the synthetic type as quick drying. Paints consisting of one or more of the pigments in combination with the various type of vehicles provide a wide variety which are sold under various trade names.

The results of atmospheric corrosion tests of specimens placed on the roof of a building in a location of rather corrosive atmosphere since nineteen thirty-seven are of considerable interest and are as follows: Nine types of paint were applied to full size tower members, and after about four years' exposure, four samples appear to be offering the best protection against the atmospheric corrosion, and are as follows in the order of their merit:

1. A paint using suboxide of lead in combination with aluminum.
2. A linseed oil vehicle with aluminum powder.
3. Spar varnish bakelite resin vehicle with zinc chromate and aluminum powder.
4. Emulsified coal tar vehicle with aluminum powder.

In observing the results of these tests, it should be recognized that the tests were started when aluminum was available, and the field was purposely limited to paints using aluminum on account of the color as the paints were intended to repaint galvanized structures. Reports from other companies using aluminum powder in a varnish type vehicle on transmission towers painted about the same time did not show as satisfactory results. In fact, the life of the coating on many of the towers was only two or three years, and this type of coating has been condemned and considered inadequate.

Although accelerated weathering tests are a part of any paint study and are used by the manufacturers in preparing their paint formulas, the results of these tests cannot be used as a definite basis for the selection of paints as there is no accepted correlation between the life of the coating in such a test and the life in actual service. However, such tests are useful as a basis of comparison of many types of paint.

There are certain types of paints which require longer aging periods and which often do not show up well in such tests. Examples of this type are paints containing suboxide of lead and those using fish oil vehicles. Due to the urgency of the situation because of the expected shortage of zinc and elimination of aluminum as a pigment, such tests are necessary at this time in order to include some of the newer paints which have recently been placed on the market. The results of an accelerated weathering test just completed seem to be of sufficient interest to be included in this report. A standard weatherometer was used which subjected the samples to alternate wetting and drying through the use of tap water sprays and ultra-violet light from arc lamps. Test panels of uniform size and thickness were coated with various paints in accordance with the manufacturers' recommendations. Periodic observations of the panels were made and a record was kept of the condition of the coating for the various periods. All panels, regardless of their condition, remained in the weatherometer to the end of the test and the final condition of the samples was about as follows: Of the eleven samples tested, four withstood the test and stood up in good condition. Of these four, three were of the alkyd chromate pigment type, one of which contained chlorinated rubber. The fourth contained an oil type vehicle with phosphoric acid and aluminum pigment. From the results of these tests, the better paints have been selected for actual repainting programs of tower lines in order to obtain a life test under actual conditions. A very complete record is being kept of the coverage, characteristics, costs, and general desirability of each type. This information is not available at this time; however, it is expected that some interesting information as to costs, coverage, and ease of handling will be available in the near future.

Much has been said before this committee in regard to standards and specifications, especially about those to supersede the old NELA Line Hardware Specifications, and you are entirely familiar with the work that has been done. In collecting information from the manufacturers in regard to the availability of materials for line construction, one manufacturer has suggested that an appeal be made at this time to the power companies to immediately adopt all EEI Standards as this would cut down the stocks required at the various plants and warehouses and assist in providing material for line construction. You will remember a year ago at Detroit another manufacturer made the same appeal and cited some specific items. Although it might appear to some that the preparation of EEI specifications should be curtailed at the present time, it is found that there is a demand for the continuation and expansion of this work in the interest of conserving the supply of material. When some forty-five hundred hardware items must be manufactured and listed for line construction, many for the same purpose with but slight modifications, it must be admitted there is still room for standardization. The savings to the manufacturer in dies, jigs, engineering, and excess material tied up in stocks is of great importance during normal times in the interest of economy, and of particular interest at this time on account of the conservation of material.

In 1941, the production of electricity by all electric light and power utilities contributing to the public supply of the United States will total 165,000,000,000 kilowatthours. To this must be added another 35,000,000,000 kilowatthours produced by industries for their own use, making a grand total now, in 1941, of 200,000,000,000 kwhr. This compares with the estimates of the Federal Power Commission that the Axis powers, excluding Japan, would have electric capacity in their own and in conquered countries capable of generating 200,000,000,000 kwhr two years hence in 1943. At that time of course, the generating capacity of the United States will have been increased still further.

American Research Committee on Grounding Continues Investigations

DURING the past year the American Research Committee on Grounding has continued its program of investigating all complaints referred to it related to the effect on water and piping materials where grounding of electrical circuits is involved. In its annual report, the Technical Subcommittee states that in the interval since the preceding report* it had investigated 19 cases in seven different localities. A complete investigation was made of each case involving the complaint of trouble and wherever practical investigations were also made at other locations in the immediate vicinity or related territory to determine how widespread the trouble might be. In some cases where trouble had not been reported nearby under conditions which appeared to be similar, inspections were made to determine what factors might explain the difference in behavior. Investigations in three localities which were of particular interest are described below.

In one locality complaints were made that the copper or copper alloy hot water tanks and part of the copper tube hot water piping had failed by pitting after only two to three years' use. In one of the cases recently installed hot water tubing showed signs of possible early failure. The water delivered in this community is of unusual composition in that it is extremely soft and of very low alkalinity. Also, at times, it carries very high free carbon dioxide plus hydrogen sulphide. At both locations where trouble had been reported, the domestic hot water supplies were maintained at very high temperatures. In one of these cases both the copper tube water service pipe and much of the interior piping carried alternating current under load conditions while in the other case no trace of current was found on any of the piping under any condition of electrical load. In both of these cases the owners of the residences were advised that reducing the settings of the thermostats for domestic hot water supply would substantially reduce the corrosiveness of the hot water. At a nearby house with the temperature of the hot water so regulated, no trouble was reported with other conditions similar.

In a second territory studied by the Subcommittee a large water purveyor derives water from two deep well sources located several miles apart. The water at both plants has a low alkalinity and is relatively high in free carbon dioxide having a pH between 6 and 6.5. At one of the plants the water is treated with lime prior to its delivery into the mains, resulting in an increase in the pH to about 7.4 and the practical elimination of free carbon dioxide. At the other plant chlorination only is used. Customers in some parts of the territory served generally receive a mixture of both lime treated and untreated water, while in other parts the principal supply is from one or the other source alone. The use of copper water tube for services and interior piping has become widespread in this territory. There have been a number of reported complaints of blue water and staining of garments or fixtures from those sections receiving water largely from the untreated supply, especially where dead-end mains were involved. Inspections were made with a view to covering the variations of treated and untreated supplies, dead-end and through mains, as well as presence or absence of alternating current on the piping.

In one section where there were several complaints, special arrangements were made to keep alternating current off the piping in two residences, while at other residences conditions were left as found so that some alternating current interchange occurred on the piping under normal electrical loads. Chemical analyses of water from these residences have been made about every two months over almost a year. The results of these analyses should give some indication whether electric current over the water piping in this territory and under the conditions of these tests has any appreciable effect in modifying the corrosiveness of the water as indicated by the copper pick-up from copper water tube. The Subcommittee stated that up to the date of the report no consistent differences in copper pick-up in pipes with or without current had been observed. The tests are being continued.

In a third locality a complaint was made of blue staining of porcelain fixtures and clothing and blue coloring of the water with addition of soap, all of which began after the water purveyor had changed the dead-end main into a through main connecting to feeder mains at widely separated points. No other complaints in the town had come to the attention of the water purveyor. The mains on this street are cement-lined cast iron with leadite joints. The water supply at the plant showed a pH of about 6 with carbon dioxide content of 10 to 12 parts per million. The alkalinity was low, about 15 ppm. Water samples taken at the residence where the complaint originated showed a pH of 6.7 with 7 ppm. of free carbon dioxide, and alkalinity of 22 ppm. Samples from another residence nearby which was located at the end of a 300-foot dead-end, cement-lined main showed a pH of 7.3 with 3 ppm. of free carbon dioxide and alkalinity of 32 ppm. The still or slowly moving water in the dead-end main was rendered less corrosive by contact with the cement lining. Conversion of the dead-end main into a through main speeded up the water flow. The consequent reduction in the contact line between the water and the cement lining resulted in the water in the main under through conditions becoming more corrosive in character than it had been before. This case is interesting because in the previous experience of the committee the tendency has been for complaints to be associated with dead-end mains rather than through mains. The difference in this instance is apparently due to the effect of the cement lining.

During the past year the American Water Works Association has independently sponsored a program of pipe tests to be conducted at New York University. These tests are intended more or less to parallel, with modifications in light of present day knowledge, tests made by the Hackensack Water Company prior to the formation of the Grounding Committee. The Technical Subcommittee was invited by the American Water Works Association, to discuss the general nature of the tests and the testing

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* EEI Bulletin, September 1940, P. 451.

Rural Electrification in the United States

PART III—"BOOM" EXPANSION, 1936-1940: THE REA

By Royden Stewart

"SUBSIDY" is a word that has been lurking, like an unacknowledged child, in the shadows just outside the rural electrification movement ever since the REA program was inaugurated in 1935. Now, with truly self-liquidating projects becoming fewer and fewer, subsidy in fact if not in name will have to be introduced soon if the expansion of electric service in farming regions is to continue at the rate it has been traveling during the past five years. And subsidy in some form will be necessary to liquidate the cost of most of the rural electric systems that have already been established or committed through REA loans totaling nearly $400,000,000.

Subsidization did not figure in the plans of the National Grange and the American Farm Bureau Federation when, late in 1934, they withdrew from the Committee on the Relation of Electricity to Agriculture and asked the Federal government to finance the building of new rural electric lines. The farm organizations saw the Federal works program as an opportunity to speed up the electrification of rural America through financing on longer terms and at lower interest rates than the utility companies had been able to obtain from private capital. The utilities, principal sponsors of the CREA, were asked to join in the new plan. The industry announced its willingness to cooperate, and appointed a committee of executives to work with the President's Power Policy Committee in formulating a practical program.

The original proposal submitted to the executives was, to say the least, ambitious. It envisioned the connecting of one million additional farms during 1935. The new distribution lines, providing service *admittedly inferior to town service,* were to be built on an area basis at a total cost of $1,000 a mile and *before it had been determined how many farmers would agree to take the service.* All investments were to be self-liquidating, financed wherever possible by private capital, in other cases by Government loans. It was believed that this program could be carried out in sections where the density of farms was four to the mile.

A survey of existing conditions convinced the utility men that the plan was not, as a whole, practical. They pointed out that: in territories already served, the average density of farms was 3.8 per mile, with only 3.3 connected, while for unserved areas an optimistic estimate was 2.5; farm tenancy and farm debt were highest, farm income lowest, in the unserved areas; most farms on which electrification could increase productivity enough to offset necessary investment in wiring and appliances alone—principally dairy, poultry and irrigated farms—were already served. They did not believe that farmers would be permanently satisfied with substandard service. And although line costs must vary with local conditions, running higher than $1,000 in some sections, lower in others, operating experience dictated a practical minimum in each case; below this minimum, operating and maintenance expenses would rise so disproportionately that overall cost actually would be higher than for standard rural construction. The executives declared emphatically that the proposal to build lines without any advance assurance of revenue was unsound.

Over a period of nine months the industry committee collected data from operating companies and held numerous conferences with the Government group. On July 24, 1935, the committee submitted its own, somewhat soberer, plan. This industry plan provided for the construction during the fiscal year 1935-36 of 79,180 miles of new rural lines to serve 206,000 farmers and 79,000 nonfarm customers, an average of 3.6 to the mile. Another 66,000 customers were to be added to existing lines through loans to finance the service facilities. Average per-mile cost of the new lines, using adequate, durable construction, was estimated at not more than $963, probably less; transformers, meters and services would add about $109 for each customer. The utility companies would be given long-term Federal loans to cover the cost. The companies would "carry" the new rural business during the development period, but to assure eventual liquidation of the investment, it was urged that the Government also lend money on liberal terms for the customers' purchase of enough wiring and appliances to make possible the full benefits of electrification. The committee announced that it had set up an organization of trained technicians to cooperate at all times with the Government in carrying out the program.

The President had already (May 11, 1935) created the Rural Electrification Administration by executive order. Morris L. Cooke, who had been vice-chairman of the Power Policy Committee, was appointed Administrator and $100,000,000 was alloted from emergency relief funds to be loaned for rural electrification projects. The private utilities, through their committee, declared that they were ready to absorb all this money and begin immediately to transmute it into jobs, material purchases and farm electric service.

It soon became evident, however, that (1) the utilities were to have a negligible part in the program and (2) within the prescribed year the new agency would be able to execute loan contracts and get construction started on projects accounting for only a small part of the fund. In March, 1936, Administrator Cooke testified that REA had signed contracts for $5,000,000 and had actually advanced "at most, a couple of hundred thousand dollars." Twenty-seven loans had been authorized, one to a municipality, 21 to rural cooperative associations, five to utility companies. No lines had been completely energized.

By this time the "emergency" label had been discarded. The REA asked Congress, through the Norris-Rayburn Bill, to authorize a ten-year program under which $400,000,000 more would be lent for rural electrification, including generating plants, transmission and distribution facilities, wiring and appliances, at a rate of not more than three per cent. Loans were to be made for a period of 25 years (as compared to 20 years under the emergency set-up) and were to be fully self-liquidating. All the expenses of REA as a lending, collect-

ing, administrative and "educational" agency were to be fully subsidized by separate annual appropriations. What constituted a worthy project, the terms of repayment and almost all other details of the program were left to the discretion of the Administrator. The Government's only security for the loans was the lines themselves.

As originally drawn, the Norris-Rayburn Bill excluded private companies as borrowers. This provision was vigorously supported by REA spokesmen and the Congressional "public power bloc," on the grounds that the utilities were not sincerely interested in expanding rural service, imposed "onerous" terms and unreasonable rates on farm customers, etc. Eventually a compromise was effected: private utilities were allowed to apply for loans, but the Administrator was instructed to accord preference to governmental units and cooperative associations. In practice this preference provision has been so administered that few private companies have borrowed from REA funds. As of December 31, 1940, the 791 borrowers from REA included only 24 private companies: 714 were cooperative associations; 53 were various public bodies. Loans to private companies were 1.3 per cent of the total allotments.

At first it was expected that much of the development would be carried out through state agencies. Eight states set up rural electrification authorities, but only one, the South Carolina body, built and operated lines on any considerable scale. REA has, in fact, had sharp clashes with state governments, particularly over the matter of regulatory authority. REA policy now appears definitely committed to the fostering of cooperatives and the elimination of state authority—*and state taxes*—from cooperative affairs.

The history of REA as a government agency has been erratic and spectacular. Morris Cooke resigned as administrator in February, 1937, and was succeeded by John M. Carmody. Harry Slattery, the present incumbent, replaced Mr. Carmody in 1939, about the time that REA lost its status as an independent agency and was made part of the Department of Agriculture. Personnel has been progressively increased until there are 1,200 permanent employees; and salaries and promotions within the organization have been the subject of sharp questioning at congressional committee hearings. Expenses, too, have grown from year to year; they are now running about $4,000,000 annually—4 per cent of the loan funds.

The coöperative protégés, aided by REA attorneys and representatives, have engaged in dozens of legal clashes with state regulatory commissions and private companies and have brought great pressure on state legislatures for exemption from both regulation and taxation.

This campaign for special legal status has been rather successful. Fifteen states have adopted the REA Uniform Electric Cooperative Act; in eight states special legislation favors the cooperatives; in twenty-one states general legislation provides for cooperative organizations, presumably including electric cooperatives. Cooperatives apparently are illegal in four states. (A private company obtained an REA loan in one of these, New York. The other three, Rhode Island, Connecticut, and Massachusetts, which have no REA lines, rank first, third, and sixth, respectively, in the nation in per cent of farms electrified.) Three states have laws exempting cooperatives from all taxation; eight others provide partial exemption. And only five states subject the cooperatives to full commission regulation. All this is what Administrator Slattery calls "a new body of law."[23] It is.

The relation of REA to the cooperatives is in many respects similar to that of a holding company to operating companies under private enterprise — but without the stringent restrictions applying to private holding companies. REA furnishes the capital and closely supervises all details of organization, construction, and operation. It exercises veto powers over rate schedules and the selection of personnel. Its information division advises consumers on utilization through literature and personal visits; publicity and "educational" releases of various kinds, including suggestions for speeches by farm leaders, are issued at the rate of about one a day. Demonstration exhibits—a modern version of the traveling "circus" used by Boston Edison Company in 1912—tour the country to help the cooperatives build load and to create interest in the formation of new cooperatives.

Most of the power distributed by the cooperatives is purchased by them at wholesale. In 1940 private utilities furnished 53 per cent of this purchased power, various public agencies 47 per cent. If REA believes the wholesale rate offered to a cooperative is too high, an additional loan is made for the erection of a small Diesel generating plant.

The physical achievements of REA are impressive in total. It has already (December 31, 1940) allotted $351,454,621 in loans and expects to increase this to $474,000,000 by June, 1942—the original program of $40,000,00 a year having been discarded. The allotments will finance about 440,000 miles of rural line (of which 270,000 were in operation by midsummer of this year) besides generating plants, wiring, plumbing, and appliances.[24] Consumers receiving service from REA-financed lines number 675,000, of which 540,000 are farmers.

REA spokesmen say they have accomplished these results by building lines in rural territories which the private utilities had refused to serve, and by reducing costs. Administrator Slattery told a congressional committee in March of this year that REA borrowers were building lines for $500 to $900 a mile, with the average less than $800. Actual (September, 1940) allotment figures for 477 lines newly energized indicate an average of $871; and individual projects have gone as high as $1,781[25]; many are above $1,000.

To compare these figures, as REA does, with private costs, there should be added the cooperative's organization expense (membership fees are usually $5) and an apportionment of REA's own expense for engineering, legal, and administrative overhead. The figures are further misleading because they *are* averages, not weighted for the varying geographic and weather conditions which are such important factors in line costs, and because the investment per customer, not per mile, is the valid unit for comparison; transformers, meters, and services for five customers cost more than the same items for two customers.

Further reservations could be cited; but it probably is true that many cooperatives are building lines for less initial cost than private utility lines built under

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[23] "Rural America Lights Up," by Harry Slattery, p. 48.

[24] EDITOR'S NOTE: Since this was written it appears that operation of priorities and allocations by the OPM may substantially affect extensions of rural lines by both REA and private utilities.

[25] California 18, San Diego. On another project, Kentucky 1, Jefferson, the allotment was reported as $71,700 for 38.7 miles—$1,853 a mile—in REA Release No. 43, December 14, 1935, and in the annual reports until 1939, when the mileage appeared as 39. In the 1940 report the mileage figure was, strangely, changed again to 56 miles *without any change in the fund allotment*. Administrator Slattery on May 23, 1941, stated: "Advances to the project totaled $70,521.07 and 50 miles of line were built. The cost was $1,410 per mile, which is exceptionally high for REA projects in this area." On September 30, 1940, nearly five years after the original allotment only 13 miles had been energized. REA allotments seem susceptible to change in this confusing manner—although usually the revision is in the form of additional loan funds "to complete the system." Determining their line costs is consequently, always an uncertain procedure. R.S.

comparable conditions. True over-all costs, considering depreciation, maintenance, and voltage regulation, are another matter.

On some of the cooperative projects, styled "self-help," the farmer-members cut and haul the poles and do the unskilled part of the line-construction labor —an economy measure employed on private rural lines thirty years ago. With REA guidance and approval, the cooperatives have made use of other cash-saving devices, including cheaper design and material in line and service equipment. Most of the expedients had previously been tried at one time or another by the private companies, which rejected many of them as uneconomic in the long run.

Share-croppers and others of very low income have been added to REA lines under a "limited service" plan by which both installation costs and quantity of service are kept low through the use of smaller wire and a 600-watt transformer. A few lights can be burned, perhaps a small radio operated, by one of these customers. To use a small electric iron, his wife must deny herself both light and the inspiration of air-borne entertainment. At least one private company experimented with 600-watt transformers twenty-five years ago, but abandoned them because customers did not want their usage of electricity to be arbitrarily limited.

The administrator recently announced a new policy: REA systems will furnish the main service entrance—meter loop, meter receptacle, main disconnect switch, and house circuit protection—to every member without charge. This simply means, of course, that the cost of this equipment will form part of the debt of the cooperative, rather than that of the member.

During the same 5-year period (1936-1940, inclusive) the privately owned utilities resumed the rapid rate of progress evidenced before the depression. Over 700,000 new farm customers have been connected to the private company lines in this period, bringing the private industry's total to 1,500,000. This expansion has been influenced both by the advent of REA and the desires of the farmers themselves. In some instances, without doubt, private companies have built new rural lines to protect territory, or for social reasons, before prudent business judgment otherwise would have sanctioned them. But faster expansion was to be expected in any case. The rise in farm purchasing power since 1935, technical improvements, the progressive spreading of the transmission networks, and the farmer's growing acceptance of urban living standards have all been favorable factors.

Table VII

REA	*Private Utility*
Cost of wholesale power .....1 cent	Cost of wholesale power .....1.5 cents
Cost of money .....2.69 per cent	Cost of money .....5 per cent
Little or no taxes	Usual taxes .....
Little or no commission regulation..	Commission regulation .....
Line cost per mile $900	Line cost per mile $1,200
Resulting voltage regulation .....15 per cent	Resulting voltage regulation ..8 per cent
Maintenance .....15 per cent	Maintenance .....5 per cent
Numerous long outages	Infrequent short outages .....
Administrative expenses in large part subsidized	Administrative expense normal

Utility engineers have continued to try to strike a balance between lower-cost equipment and reliable service life in their new rural line construction. The development of light, strong conductors has made it possible to place poles 600 feet apart in flat treeless territory; new methods of pole treatment and installation; new types of transformers and other equipment have helped to bring rural costs down appreciably without jeopardizing either the service to the customer or the company's investment. The privately financed lines, in general, have higher initial cost, lower maintenance expense, higher customer density, and considerably greater energy consumption than the REA projects. The private companies believe their prospects for staying in business and giving good service are the better of the two. Table VII is a rough comparison made by a competent engineer who has served as consultant on REA projects.

American taxpayers will soon have almost half a billion dollars invested, through REA loans, in rural electric systems. Is this investment truly self-liquidating? Can the borrowers repay the government loans in twenty-five years, as promised—or ever? REA has presented summary tabulations to Congress showing a low percentage of delinquencies and advance payments sufficient to make the total of repayments exceed the total due. But what is a delinquency? The 1939 annual report of REA states:

> In the REA financing . . . the effort has been to make allowance for "thinness" and for the difficulty of pay-out in terms of the loans. As was pointed out . . . on the more recent loans the 25-year period of repayment authorized by the statute was substituted for the 20-year period which was used earlier, and interest payments were scheduled to start after two-and-a-half years, with no payments on principal until the end of the fourth year.

It should be added that the terms of many 20-year loans have been revised for a 25-year payout; that the administrator has authority to defer interest payments for as long as five years; and that borrowers are not technically in default so long as they continue to pay interest —principal payments can be deferred for the full 25-year period. Since the average weighted age of all the projects is still less than two years, any current totals on repayments point to no valid conclusion except that REA terms, through necessity or choice, are very lenient.

Even under these terms, the interest and principal payments past-due on June 30, 1940, amounted to $79,837.01, on 26 loans; three months later they had increased by 75 per cent, to $139,369.08, on 36 loans.

For some light on our prospects as lenders, then, we must look at the security itself: the REA projects as going business enterprises. They are run somewhat differently from private businesses. They do not set aside money to cover depreciation on their equipment—though equipment does depreciate. Insurance as protection against disaster also is surprisingly low.

Let us see how much money the cooperatives have left from their operations to pay on their debt.

For the third quarter of 1940, 558 cooperatives outside of the TVA area had total revenues of $5,658,388 and total operating expenses of $3,406,372, leaving $2,252,016.[26] Extended on a yearly basis for 484,000 customers, the statement for each customer appears in Table VIII.

These cooperatives owe the government — the taxpayers — $199,941,214.

[26] These figures have been assembled from "Financial and Operating Statistics of All Systems to Which REA Had Made Allotments as of September 30, 1940," released by REA. The operating expenses total does not tally with similar entries in the REA report, which show total expenses for many cooperatives at figures slightly larger than the sum of the individual items. Number of customers used is average for the year.

TABLE VIII—INCOME PER CONSUMER

Third Quarter of 1940
558 REA Cooperatives outside of TVA Area
484,000 Consumers

Annual revenue per customer	$46.76
Expenses:	
Payroll	$ 8.56
Purchased power	11.18
General	5.91
Insurance, taxes, miscellaneous	2.49
Total expenses	28.14
Balance for interest and principal	$18.62

Allowing 8.25 per cent for installation loans and loans on line still under construction, the total investment applying to lines in service is $183,500,000, or $357 for each customer.

The $18.62 "balance for interest and principal" constitutes 5.21 per cent of this average cost. If depreciation is taken at the rate set by the Tennessee Valley Authority for its distribution lines, 3.91 per cent, there is left only 1.3 per cent, which is just half the cost of money to the U. S. government in 1940. We shall have to forget the principal.

But the REA systems are young. Isn't it possible that, after the manner of growing businesses, they will gradually pick up more customers and that the customers will use more energy, so that the revenues will some day be sufficient to meet the fixed charges, including the debt installments?

In view of their present financial condition, hope for eventual liquidation of most of the loans must be based on this presumed growth. Mr. Slattery has furnished the House of Representatives Appropriation Committee with a table based on operating records of 567 borrowers for the month of July, 1940. The figures are arranged in age groups according to the number of months that the systems have been in operation. The oldest groups are highest in customer density and consumption, and this comparison is presented as evidence of marked improvement in operating ratios as the systems grow older. Unfortunately, another interpretation is just as plausible: that the first lines built occupied the best territory. If this is true, the new projects, instead of being merely on their way up, are in such "thin" territory that ultimate pay-out prospects are poor indeed. Recently Mr. Slattery wrote:

"As the program advances, unserved areas become progressively thinner."[27]

A more comprehensive and revealing table can be assembled from the operating statistics of the individual systems, reported by REA as of September 30, 1940. This shows the operating ratios one year after energization for groups of lines energized in the summers of 1937, 1938, and 1939. While customer density remains fairly constant around two per mile, the customers on the newer lines are using less energy and more of them are paying minimum bills—although in each case the lines have been in operation one year. The 1939 group has annual revenue of $41.68 per customer and, when operating expenses as shown in Table VIII are subtracted, only $13.54 to apply against depreciation, interest, and principal for a year.

These discouraging indications do not apply to every individual REA line, of course. Some projects, especially in the regions where power is used for irrigation, report consumption and revenue figures that, if maintained, should assure loan liquidation. Defense industries and Army training camps are now providing a temporary "shot in the arm" for a few. But many others are considerably below the group averages, some under 25 kilowatt hours a month per customer. Obviously the limited-service users cannot be counted on to increase their consumption much. All this is in spite of the half-million dollars a year that REA is spending for load-building activities.

Thus, from the strictly business standpoint of the lenders—in this case, all of us, including the farmers—the REA accomplishments as a whole are somewhat short of satisfactory. And a farmer using only 50 kilowatt hours a month isn't adding much to his own income through electric service. But rural electrification, both the private utilities and the REA have declared, is a social as well as an economic matter. If farm living has been improved appreciably by the REA expansion perhaps the nation can afford to charge off a few hundred million dollars to progress. The farmers receiving REA service have lights, at least. What else?

A recent survey of an unstated number of REA consumers showed that most of them buy radios and irons, but less than one-third have mechanical refrigerators; only 15 per cent have bought water-pumps—although running water in the house is surely one of the most widely accepted standards of modern living. Only 8.5 per cent have bought bathtubs or showers; 14.6 per cent have bought small motors.[28]

Both REA itself and the Electric Home and Farm Authority make loans for wiring and installation on farm premises, but EHFA is the principal credit agency for appliance purchases. Only 25,000 consumer-members of REA and TVA have borrowed from EHFA, their loans averaging $155 each; over 600,000 more have not asked for, or could not get, these loans. Very few REA consumers have bought the $700 worth of wiring and appliances they need to make electrification profitable.

This saturation percentage of utilization equipment undoubtedly is the clue to the low energy consumption. Two REA administrators have stated that no farm can be considered electrified unless it is using 100 kilowatt hours a month. REA's best year group in Table IX averages 57 per cent of this goal. The average per-farm consumption for all connected farms in eastern United States was 94 kilowatt hours a month in 1939; the addition of thousands of low-use REA consumers brought it down to 89.4 in 1940.

The cooperatives have found, as did the private companies, that the most desirable rate structure is a block schedule with a minimum monthly bill. Except in the TVA area, minimum charges on REA lines run from $1 (for 10-12 kilowatt hours) to $5 a month. The important point to the consumer, however, is the price he is actually paying accord-

(*Continued on Page* 468)

TABLE IX—REA COOPERATIVES (EXCLUDING TVA)

Operating Ratios for Month of September
Lines in Service One Year

Age-Group	*Customers per Mile*	*Kw.hr. per Customer*	*Kw.hr. per Mile*	*Revenue per Kw.hr. Sold*
Energized in 1937 (27 lines)	2.05	56.8	116.5	6.29¢
Energized in 1938 (39 lines)	1.96	54.2	106.2	6.53¢
Energized in 1939 (48 lines)	2.04	50.7	103.5	6.92¢

[27] "The Agricultural Situation"—Dept. of Agriculture, March, 1941.

[28] Statement by Administrator Slattery; Hearings H.R. Comm. on Approp., Agriculture Dept. Approp. Bill for 1942, p. 189.

MKB Sales Training Films Prove Valuable to Utilities

Edwin Vennard New Chairman of Modern Kitchen Bureau

MR. VENNARD

EDWIN VENNARD, Vice-President of Middle West Service Company, Chicago, Ill., will serve as Chairman of The Modern Kitchen Bureau for 1942.

Mr. Vennard will bring to the Bureau wide experience and knowledge of utility and dealer merchandising practices in many areas of the country, which will prove valuable in guiding Bureau operations during the next year.

After graduating from Tulane University, Mr. Vennard spent a year with the General Electric Company Testing Department, and then joined Gulf States Utilities Company as power sales engineer. He later took the same position with Southwestern Gas and Electric Company, an operating unit in the Middle West System, and was advanced to commercial manager in charge of sales and rates, before joining Middle West Service Company. His present duties include sales, rates, advertising, employee information and customer relations.

Mr. Vennard succeeds W. H. Sammis, Vice-President, The Commonwealth & Southern Corporation, New York City, Chairman of The Modern Kitchen Bureau since June, 1939.

HOW electrical appliance salesmen welcome the concrete, specific information, on sales training and selling of individual appliances, that has been made available to the electrical industry by The Modern Kitchen Bureau in its series of sales training films, is shown by the experience of the Bluefield, West Virginia, Division of the Appalachian Electric Power Company.

The eight salesmen, and members of the sales promotion staff of this division, have taken the course, and have already begun a review of this material. Two classes, consisting of about 40 appliance dealers, are at present taking the course.

Describing the method in which his company used these films, Herman E. Kirchner, Manager of Residential Sales, writes: "The attached picture was taken at the close of a three-day program in a camp in Virginia. This group gave up a Sunday and Labor Day to enable them to take the course. Each man was more than enthusiastic in his praise of the good he had received from the lessons. Considering the fact that all eight of our salesmen have earned membership in the Hotpoint Redmen's Club by selling a minimum of $10,000 worth of ranges and water heaters during the first nine months of the year, and have averaged better than $16,000 a man, is an indication that this is not a bunch of scrub salesmen. Yet they were sufficiently interested to spend as much as four hours on one lesson, and voted unanimously for a review.

"We wish to express to you and your committee on the preparation of the sales training course, our appreciation for this very excellent contribution to the industry . . . we speak with complete understanding when we say that the committee is to be congratulated on producing this program."

Form Complete Course

The Bureau's series of ten sound-slide films make up a complete sales training course, both for giving cubs a dramatic presentation of the facts they need to become quick producers, and to allow veterans to review their methods in the light of present knowledge.

Five product films, dealing with specific appliances, yet not mentioning particular makes, cover in detail the selling of electric refrigerators, ranges, water heaters, washers and ironers, and roasters.

The five basic selling films give the concrete facts that every salesman needs to sell any appliance. Their titles are: "How to Build a Prospect List," "Getting the Right Start," "Demonstrating to Sell," "Answering Objections," and "How to Close."

The Modern Kitchen Bureau suggests that these films will be shown most

Salesmen and members of the Sales Promotion Dept. of the Appalachian Electric Power Co., Bluefield, W. Va., Division, after studying the MKB sales training films in a three day program.

effectively at meetings of not more than twenty men, and when combined with discussion periods to drive home the effectiveness of sales points shown in the films. Each film will come with questions and answers for quiz sessions that can be held with the showing of each film, and with manuals containing suggestions for profitable use of the films.

Utility executives interested in seeing these films and in securing prices, may address The Modern Kitchen Bureau, 420 Lexington Ave., New York City. Requests will be forwarded to Vocafilm Corp., producers of the films, whose representatives are located at strategic centers throughout the country and who will be glad to arrange showings, without obligation.

Commercial Cooking Conference Papers Available

TRANSCRIPTS of the papers delivered at the Fifth Annual Commercial Electric Cooking Conference, held at Chicago, October 9, under the auspices of the Commercial Electric Cooking Council, and the informal discussion that featured this conference, have been reproduced by the Council and are now available.

The importance of this meeting is attested to by the fact that attendance was the largest in the five-year history of the conference. Those commercial executives who found themselves unable to attend will find the transcripts of the papers and discussion invaluable in planning their activities for 1942.

Methods used in selling electric counter cooking service in competition with cheap natural gas . . . the latest information from equipment manufacturers on the effects of the defense program and shortages of materials on the design and supply of electric cooking equipment during 1942 . . . and the results of extensive tests to determine commercial electric cooking customers and equipment characteristics, are only three of the many high caliber presentations heard at the conference, and now offered in these transcripts.

Questions and problems important to every commercial executive, his company and his promotional work for the years ahead were discussed and answered by experts known wherever commercial cooking service is sold.

Transcripts may be ordered from the Commercial Electric Cooking Council, 420 Lexington Ave., New York City, at $1.00 per copy.

Rural Electrification in U. S. A.

(*Continued from Page* 466)

ing to his total bill. REA's best group in Table IX has an average price of 6.29 cents a kilowatt hour. This is 43 per cent more than the average price of 4.41 cents paid by all eastern farm electric customers in 1939 and 1940.[29]

The typical REA consumer, then, pays more for his electricity than other farm electric customers, uses less of it, and hasn't much chance of enjoying its full benefits until he is willing and able to multiply his present investment in utilization equipment several times. He has electric service, but it cannot fairly be said that his farm is electrified. The prospects of improving these conditions are not bright in most of the areas served by REA cooperatives, and they are bleak along many of the lines now being planned. The new territories are "thin" indeed, both in density of farms and economic status of the occupants. The limited-service plan and the service-entrance concession seem designed to make the most of this situation in order that REA may continue to build lines and connect customers of whatever quality.

Altogether, about 1,300,000 farms have been connected to electric distribution lines in the past five years. The private utility companies, which added 60 per cent of them, now show signs of slowing their rate of expansion, reflecting the generally less promising character of the territory still unserved. Last year, for the first time, less than half of the new farm electric consumers were connected to privately owned lines. REA, on the other hand, is increasing its pace. If the present rate is maintained, all of the $100,000,000 asked for fiscal 1942 will have been allotted by the fall of 1941.

What may we expect in the next five years—let us say, until the original authority for REA lending expires in 1946? The time is already approaching when new lines, if they are to be built at all, can serve less than two customers to the mile, in many cases only one. But there is no reason to believe that higher investment per customer and lower revenue per mile will stop the march of REA. They need not, so long as loan terms and the definition of "self-liquidating" are matters for the judgment of the head of a growing government bureau. If lines wear out and loans default, there can be, and probably will be, refinancing — in effect, subsidy, though it is unlikely to be called by that name. The government will not foreclose its mortgages. For what can you do with an electric distribution system except distribute electricity?

The farmers have got the service, and the American people will not take it away from them.

Perhaps, sometime after 1946, even the less-than-$500 buildings which are the only dwellings on 2,000,000 farms will have electric lights. By one definition the farms of America will then be completely electrified. But they may still be some distance from the full utilization of electricity which the CREA set up seventeen years ago as the goal of the rural electrification movement.

[29] EDITOR'S NOTE: Since this article was written, the REA published new data as of March 31, 1941, which are here summarized. The data for March, 1941, have been developed by adding together the state-by-state figures shown in the booklet "Allotment, Construction and Operating Statistics, REA-Financed Systems, March 31, 1941". Figures for September, 1938, 1939 and 1940 were computed from data in the typewritten statement "Financial and Operating Statistics of All Systems to Which REA had made Allotments as of September 30, 1940."

REA Cooperatives (Excluding Those Supplied by TVA) Summary of Reported Operations for Cooperatives Making Complete Returns in Each Period

Date	Number of Coops Making Complete Reports	Miles of Line Energized	Number of Customers	Customers per Mile	Av'g Price per Kwhr
Sept. 30, 1938.....	241	54,783	113,036	2.06	7.00¢ (a)
Sept. 30, 1939.....	397	130,548	282,164	2.16	6.48¢ (a)
Sept. 30, 1940.....	573	230,560	523,301	2.27	6.50¢ (a)
Mar. 31, 1941.....	618	260,953	606,031	2.32	6.32¢ (b)

(a) Average for the month of September. (b) Average for 9 months ending March. Total revenues for this period were $18,404,000.

During the 9 months ended March 31, 1941, the above cooperatives consumed 291,050,000 kwhr, or approximately 534 kwhr for each of the 545,000 average customers of this period. This compares with approximately 830 kwhrs for all of the farms served by all concerns—public and private—in the non-irrigation areas of the United States during the same period. The average price of 6.32¢ per kwhr paid by consumers of the cooperatives compares with 4.25 cents for all farm consumers in the non-irrigation areas.

This booklet also shows the funds advanced for construction. Recent figures are as follows:

Construction Funds Advanced to the Above REA Cooperatives

Date	Total	Per Mile Energized	Per Consumer Connected
Sept. 30, 1940	$203,369,362	$883	$389
Mar. 31, 1941	239,866,507	919	396

The Waterman Report on Holding Company Operations

ECONOMIC IMPLICATIONS OF PUBLIC UTILITY HOLDING COMPANY OPERATIONS—With Particular Reference to the Reasonableness of the Death Sentence Clause of the Public Utility Holding Company Act. By Merwin H. Waterman, Professor of Finance, University of Michigan School of Business Administration. University of Michigan Press, Ann Arbor, Mich., 180 pages, price $1.00.

THIS book is a study and critical analysis of operating and financial characteristics of independent operating utilities in comparison with holding company subsidiaries, and in their relationship to the regulatory devices of Section 11 (b) (1) of the Holding Company Act. Particular emphasis is given to the relative cost of utility service to consumers.

The rate data was obtained from the Federal Power Commission publications, "Typical Electric Bills—1940." The data with respect to operating costs were taken from annual reports made by utility companies to the Federal Power Commission. Data regarding costs of raising money were taken from publications of the Securities and Exchange Commission. Moody's Manual of Public Utilities—1940 was used for certain purposes where it was more convenient as a source than the above-mentioned sources. The information respecting effectiveness of regulation was obtained by Dr. Waterman through correspondence and interview with a large number of state commissions.

Dr. Waterman makes clear that the study reported in this volume (Volume IX, Number 5 of Michigan Business Studies Series) was made possible by funds furnished by Engineers Public Service Company in the desire of its management to determine the facts regarding relative performance of independent and subsidiary companies as a whole. Testimony based on the facts reported in the study was admitted as evidence by the Securities and Exchange Commission this summer in the company's challenge of the reasonableness of Section 11 of the Holding Company Act.

A summary of the book's findings is contained in Dr. Waterman's own conclusions. He writes:

"1. Control and operation of public utilities by holding companies does not appear to impose a relatively detrimental influence either on the consumers or on investors in operating utilities. As compared with consumers of and investors in independent operating utilities the consumers and investors dependent upon subsidiary companies fare at least equally well. This fact is established for consumers by the coincidence and consistency of results which show that, on the average, residential electric customers of independent utilities pay as much or more for their current than do the customers of holding company subsidiaries. For investors, the lack of any significant relationship between the average quality of operating company bond and preferred stock investments on the basis of ownership leads similarly to the conclusion that investors as a whole do not suffer relatively from holding company control of operating utilities.

"The tests and analysis of managerial economy and soundness of financial management do little more than substantiate and make more reasonable the conclusions as noted. They evidence no instances of significant misfeasance or malfeasance on the part of holding company management as compared with independent utility management, thus making it appear only logical that investors and consumers related to the two groups of companies should expect to fare at least equally well.

"Obviously this is not to say that all or any holding companies offer the best utility management available to consumers and investors or that holding company control of utilities is inevitably in the public interest. Such a conclusion would be as illogical and unreasonable as the one on which Sec. 11 (b) (1) of the Public Utility Holding Company Act is based; namely, that all holding companies are inevitably bad and against the public interest. It is only determined that, on the strength of the complete coverage of independent and subsidiary utilities contained herein, holding company performance averages as well as independent utility performance.

"2. In face of the facts it follows that the attitude of the law as embodied in Sec. 11 (b) (1) of the Public Utility Holding Company Act is unrealistic and unreasonable and the administration of the law by the Securities and Exchange Commission, necessarily, perhaps, is similarly unrealistic and unreasonable. The law prescribes and the Securities and Exchange Commission proposes to follow the requirement that all holding company systems shall be disintegrated and relegated practically to the status of independent utilities. On the basis of the evidence here at hand there is no reason to believe other than that the fulfillment of this process will 'average down' the performance of gas and electric utilities in this country and bring no overall benefits either to consumers or investors.

"3. From the standpoint of utility regulation there exists evidence to the effect that holding company subsidiaries are as effectively regulated by the various state commissions as are their independent contemporaries. Certainly the regulatory provisions of the Public Utility Holding Company Act itself are comprehensive and touch most significantly on those points, such as finance, accounting and intercompany relations, where state regulations tends to be weakest. Therefore, disintegration of holding company systems will, as it goes forward, tend to lessen the degree and perhaps the quality of regulation to which operating utilities will be subject.

"4. Economic reform and reformers always have their guns out for 'bigness' and, truly enough, they can always find examples of coincident 'bigness' and inefficiency. But any pseudo reasoning to the effect that big utilities, or even big utility holding companies, are necessarily uneconomic, inefficient and detrimental to the public interest is squelched by the consistent array of facts relating to the utility industry. From the standpoint of consumers there is every evidence that, again relatively, they benefit from increasing size of operating utilities and at least suffer no detriment as size of holding system increases. This conclusion is but in line with the operating characteristics of utilities, and although there are likely some limits to the economics of size, those limits have not as yet been satisfactorily defined or isolated from the influences of other factors related to the efficiency of utility operation and management.

"5. Conclusions regarding the question of the significance of operating utility location in relation to holding company headquarters may be simply dismissed with the reminder that any apparent correlations could as easily be explained in terms of actual geographic location of the operating properties."

Accident Prevention Committee Meeting

George S. Diehl, *Chairman*

THE fall meeting of the Accident Prevention Committee, and the first one presided over by the new Chairman, Mr. George S. Diehl, of the Pennsylvania Water and Power Company, Baltimore, was held at the General Offices of the Edison Electric Institute October 27 and 28. To a considerable extent this was an organization meeting as new assignments had been made to a number of subjects under study by the Committee. The subjects and those designated as sponsors are as follows:

Round Table Discussions—W. A. BUCHANAN, Appalachian Electric Power Company.

Employee Training—C. N. RAKESTRAW, Cleveland Electric Illuminating Company.

Occupational Diseases—E. E. GROVER, Columbus & Southern Ohio Electric Company.

Public Safety—A. A. RALL, Kansas City Power & Light Company.

Shops, Commercial Departments & Offices—F. W. BROCKHOFF, Union Electric Company of Missouri.

Street and Highway Safety—H. F. WEBB, West Penn Power Company.

Resuscitation—W. R. SMITH, Public Service Electric & Gas Company. (Mr. Smith will also serve as liaison representative with the AIEE Committee on Safety.)

Cooperation with National Safety Council—A.S.S.E., R. M. GODWIN, Philadelphia Electric Company.

Low Voltage Hazards—C. B. BOULET, Wisconsin Public Service Company.

Electric Stations—D. C. STEWART, Buffalo Niagara & Eastern Power Corp. R. DUELAND, Ebasco Services Inc.

Employee Health—WILLS MACLACHLAN.

Steam Stations—F. H. DAVIES, The Detroit Edison Company.

Statistics—E. J. KREH, Duquesne Light Co. D. C. STEWART, Buffalo Niagara & Eastern Power Company. H. F. WEBB, West Penn Power Company. (Mr. Kreh will also serve as liaison representative with the Accident Prevention Committee of the American Gas Association.)

Overhead and Underground Work—H. O. SPRINKLE, Monongahela West Penn Public Service Company. (Mr. Sprinkle will also serve as liaison representative with the Transmission and Distribution Committee of the Edison Electric Institute.)

Publicity—W. T. ROGERS, Ebasco Services Inc. (Mr. Rogers will also serve as liaison representative with the Insurance Committee of the Edison Electric Institute.)

Hydraulic Power—GEORGE S. DIEHL, Pennsylvania Water & Power Company. (Mr. Diehl will also serve as liaison representative with the Hydraulic Power Committee of the Edison Electric Institute.)

Standardization—A. B. CAMPBELL, Edison Electric Institute. (Mr. Campbell will also serve as liaison representative with the American Standards Association.)

A subject that was discussed at considerable length was the Presidential Proclamation relating to the National Emergency Safety Campaign. (See page 380 of the September issue of the EEI BULLETIN.) Ways and means were discussed for utility company cooperation with this campaign and it was decided that utility companies could best help to attain the national objective by intensifying their present activities as follows:

"*On the job.* Intensify accident prevention work among employees. Increase plant protective arrangements and stimulate fire prevention activities. Company officials and Departmental Executives should display interest on every occasion and wholeheartedly back the safety department in this effort. Use the Presidential Proclamation for stimulating increased interest where it can be used effectively.

"*Off the job.* Through safety meetings, distribution of safety literature, posters and other educational material, to work for a substantial decrease in accidents of employees and their families off the job—in the home, on the highway and other outside activity.

"*Community Activities.* Assist all federal, state and local bodies concerned with this campaign to reduce accidents. It might be desirable, depending on local conditions, to offer the services of the company's safety department and those concerned with first aid for community purposes. Company Publicity Directors might wish to send literature pertaining to this emergency safety campaign to District Managers for use in local papers, churches, clubs, schools, farm groups and other similar organizations."

As a result of careful consideration given to the matter of the collection of accident statistics at this and several previous meetings of the Committee, it was decided to recommend changing from the method of collecting accident statistics that has been followed for many years in the past, to the system of Compiling Accident Statistics as set forth in American Standard Z16.1-1937. This recommended action has since been confirmed by the Operating Committee of the EEI.

An interesting address, illustrated by lantern slides, was presented by Dr. M. S. Viteles, Director of Personnel and Research Training of the Philadelphia Electric Company, on the scientific approach for selecting the right man for the job. Dr. Viteles described tests that have been developed by the Philadelphia Electric Company, under his guidance, whereby men having the proper characteristics are selected for such important work as substation operators, linemen, cable splicers, etc. While these tests have been under way only a few years, the results have been gratifying, and these tests, with such changes as may be indicated by experience, will be continued. There was a very interesting and lively discussion following the address by Dr. Viteles indicating a deep interest on the part of all members of the Committee in this subject.

An interesting discussion was held under the leadership of W. A. Buchanan on Round Table Discussion. One of the subjects in this discussion which proved of greatest interest, was the methods used by various companies for conducting discussions by employees on safety and accident prevention. The methods of visual instruction, the sizes of groups and the method of obtaining participation by employees were discussed at considerable length.

A demonstration was given by representatives of the Mine Safety Appliances Company, with an Artificial Respiration Trainer. This is a device for recording the performance of those trained in artificial respiration in timing, pressure applied, and depth of patient's breathing. It was the consensus of those present that this instrument should be helpful in producing more uniform results in applying artificial respiration where the Prone Pressure Method is employed.

Several other reports, including plans for future work, were made by:

H. O. Sprinkle—Transmission Problems
C. N. Rakestraw—Employee Training
D. C. Stewart—Safety in Electric Stations
F. H. Davies—Safety in Steam Stations
G. S. Diehl—Safety in Hydraulic Stations
C. B. Boulet—Low Voltage Hazards
W. R. Smith—Resuscitation
E. E. Grover—Occupational Diseases
F. W. Brockhoff—Safety in Shops, Commercial Departments, and Offices
H. J. Burton—New Ideas, Devices, and Materials.

It was decided that an effort would be made to hold the winter meeting some time during February, and at a place where one joint session might be held with one of the other engineering committees.

Conservation of Materials for Defense Wiring

(*Continued from Page* 450)

lic outlet boxes throughout will have conserved steel that may be used for more vital purposes.

Following is a partial list of some points for simplifying wiring systems, which if applied to the nation as a whole, will release appreciable amounts of steel, copper, and rubber for sorely needed facilities.

1. Use no conduit or steel tubing except in those types of construction where its use is necessary.
2. Use no steel outlet boxes where porcelain or composition boxes could be used.
3. Use non-metallic sheathed cable of the covered neutral type of assembly.
4. Where armored cable is required for some special reason, use the bare neutral type.
5. Where construction requires raceways, use a bare neutral conductor and thin-wall insulation on insulated conductors.
6. Where raceways are required, use electric metallic tubing (thin-wall conduit) in preference to rigid steel conduit wherever practical. Fiber duct and transit conduit may also be used in many cases particularly on the larger sizes.
7. Use the neutral conductor as a grounding conductor throughout the wiring system.
8. Use multiwire branch circuits, with a common neutral wherever possible.
9. In revamping old installation now using "double fusing," convert to grounded system and obtain *double the number of circuits*, with the same fuses (or breakers).
10. Where additional wiring capacity is needed for existing 2-wire branch circuits, 50 per cent to 100 percent additional can be obtained with same wire in many cases by converting to 3 and 4-wire multiwire branch circuits.
11. Make use of thin-wall insulating mediums for cable assemblies.

There are of course many other economy hints that may be added to the above discussion, but these at least should serve to stimulate the thinking toward the conservation of precious resources.

New Edition of Important Book on Industrial Accident Prevention

Industrial Accident Prevention, by H. W. Heinrich, 448 pages, 154 illustrations. Price, $3. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y.

THIS revised edition of Industrial Accident Prevention is timed to take its place with other aids to the national movement for defense production, in which the elimination of needless human loss, property damage, spoilage and loss of production hours play no small part.

In the new edition the chronology and the historical background of the industrial safety movement are covered in considerable detail. In typical newspaper style the whole story is told in narrative form in the first chapter and detailed explanation and examples are given in subsequent chapters.

In a new chapter entitled "The Basic Philosophy of Accident Prevention" the author includes a list of safety axioms and sections dealing with responsibility for accident occurrence and prevention, the accident sequence, man versus machine, reasons for the unsafe habits of men, the analogy between methods of controlling production faults and accidents and the costs of accidents. Thus in preliminary form are condensed all of the arguments and approaches that are required to consider the problem of prevention itself.

The three principles of the accident prevention problem described by the author as creating and maintaining interest, fact finding and corrective action are covered separately in following chapters.

In the chapter on fact finding the author disposes of a great variety of accident facts by grouping them in the order of their value as direct or proximate causes, sub-causes, underlying causes, identifying facts and corollary facts. The treatment is interesting and much more simple than would appear from the description. In carrying on safety work as is advocated in the text the major emphasis is logically placed on the value of the direct or proximate accident causes. In fact, throughout the book there is frequent repetition of the thought that practical accident prevention, when carried on intelligently and effectively, is always direct and simple.

New chapters on occupational disease, safety organization, first aid and hospital, and fatigue have been included. Sample forms for use in accident investigation and fact finding have been added.

The revised edition is a valuable and timely addition to current literature on industrial safety and of special value because of its emphasis on the control of a factor of considerable importance in maintaining the continuity of production for defense.

American Research Committee

(*Continued from Page* 462)

methods to be employed and to keep in touch with the progress of the tests after they start.

One of the simpler methods of testing for pipe corrosion mentioned in last year's report by the Technical Subcommittee, namely, a water drip test, was set up on a trial basis during the year. Water from four coils of copper tube was allowed to drip on unglazed porcelain plates, to determine whether the scheme could be practically applied under a minimum of supervision. The Subcommittee reports that so far the results have not been wholly satisfactory but the work is still under way.

During the coming year it is planned to continue investigations where complaints are made of water contamination or pipe deterioration, and grounding of electrical systems to water pipes is involved. The Technical Subcommittee also hopes to work closely with representatives of the American Water Works Association in connection with the pipe tests mentioned above.

EEI PUBLICATIONS

A newly revised price list of all EEI publications is available upon request to

EDISON ELECTRIC INSTITUTE
420 Lexington Avenue
New York, N. Y.

PERSONALS

ROBERT F. PACK has resigned as president of the Northern States Power Co., Minneapolis, Minn., but has indicated his willingness to remain as chief executive of the company until December 31, 1942, to give the stockholders, through the directors, opportunity to select his successor. Mr. Pack has agreed to be available in an advisory capacity, following his resignation.

Mr. Pack joined the Minneapolis General Electric Company in 1912, serving as general manager until 1916. From that year until 1931 he was vice-president and general manager of the Northern States Power Company, and since 1931 he has been president and general manager of both companies.

In the course of his career, Mr. Pack has made outstanding contributions to the electric light and power industry, not only as one of its most progressive executives but also as an active participator in the affairs of its representative engineering associations. After a period of active service on its various committees, he was elected president of the National Electric Light Association in 1926. Before coming to this country, Mr. Pack has been secretary and general manager of the Toronto Electric Light Co., from 1891 to 1912. He was elected to the presidency of the Canadian Electrical Association in 1912. Mr. Pack has also been an active member of the American Institute of Electrical Engineers.

CLARENCE W. MAYOTT, manager of the Connecticut Valley Power Exchange and a member of the technical staff of the Hartford Electric Light Company has been "borrowed" by the Office of Production Management to serve as administrator of the interconnected power system resulting from the pooling of 40 publicly and privately owned utility companies in 13 states to assure adequate power for vital defense activities in the Southeast.

E. M. LAUSE has been appointed vice-president and general manager of the Washington Gas and Electric Co., in Tacoma succeeding T. E. Roach, who recently became assistant to the president of the Pacific Power and Light Company.

Starting in the utility field in 1920 with the Albert Emanuel Company, Mr. Lause was sent after a short time to West Virginia where, until 1925, he was vice-president and general manager of the Williamson Electric Co. He then joined the Kansas Electric Power Co. in the capacity of sales manager.

In 1931 Mr. Lause went to Charleston, W. Va., as vice-president and general manager of Southeastern Gas and affiliated companies, and in 1936 was transferred to Toledo, Ohio, as president and general manager of subsidiary companies of Ohio Service Holding Corp. For the past two years he has been a special representative of Loeb & Eames, Inc., operating electric and gas properties in the Middle West.

GEORGE H. WISTING, assistant general manager of Northwestern Electric Co., Portland, in charge of new business has been granted a leave of absence by the company to become vice-president and director of the Columbia Aircraft Industries, Inc., a local concern organized to make airplane parts. JOHN C. PLANKINGTON, formerly manager of commercial and industrial sales for the Northwestern Electric Co., will assume Mr. Wisting's duties as head of the new business department.

GEORGE STORMINGER, formerly general foreman, cable section, underground and transmission construction department, Public Service Electric and Gas Co., Newark, N. J., has been appointed assistant engineer and assigned special duties in connection with cable installations, engineering and developing work. Mr. Storminger has been connected with Public Service since 1912.

L. A. WILLIAMS, for the past five years manager of the Everett district of the Puget Sound Power and Light Co., has been appointed as executive assistant to the president, Frank McLaughlin, with headquarters in Seattle. R. W. JOYCE, now assistant to the manager of the central division in Seattle, has been appointed to succeed Mr. Williams. J. W. WALLIN, manager of the company's office in Kirkland, will succeed Mr. Joyce. Mr. Williams has been with the Puget Sound utility for seven years, serving as advertising manager and advertising sales promotion director. He was transferred to Everett as manager in 1936.

CONVENTIONS AND MEETINGS

DECEMBER

1-2 Prime Movers Committee, EEI Headquarters, New York, N. Y.
1-5 American Society of Mechanical Engineers, New York, N. Y.

1942

JANUARY

21-23 American Society of Civil Engineers, New York, N. Y.
26-30 American Institute of Electrical Engineers, New York, N. Y.
26-30 American Society of Heating and Ventilating Engineers, Philadelphia, Pa.

FEBRUARY

2-3 Electrical Equipment Committee, EEI, Pittsburgh, Pa.
9-11 Transmission and Distribution Committee, EEI, Hotel Cleveland, Cleveland, Ohio.
16-20 National Electrical Manufacturers Association, Palmer House, Chicago, Ill.

APRIL

20-22 Sixth National Accounting Conference, AGA-EEI, New Jefferson Hotel, St. Louis, Mo.
27-30 Chamber of Commerce of the U. S. A., Washington, D. C.

MAY

11-15 National Fire Protection Association, Atlantic City, N. J.

JUNE

1-4 EDISON ELECTRIC INSTITUTE, annual convention, Atlantic City, N. J.

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